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**216 PATERSON PLANK ROAD SITE  
CARLSTADT, NEW JERSEY**

**FINAL WORK PLAN AMENDMENT  
FOCUSED FEASIBILITY STUDY: FIRST OPERABLE UNIT SOILS  
AND  
ADDITIONAL OFF-PROPERTY INVESTIGATION**

**Prepared by:**

**The 216 Paterson Plank Road Cooperating PRP Group**

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**December 1995**

**Project No.: 943-6222**

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## EXECUTIVE SUMMARY

This Work Plan Amendment is submitted on behalf of the 216 Paterson Plank Road Cooperating PRP Group and provides the framework for the next phase of remediation at the 216 Paterson Plank Road Site in Carlstadt, New Jersey. This Work Plan includes a Focused Feasibility Study (FFS) for the First Operable Unit (FOU) soils and an Off-Property Investigation to further evaluate the nature and extent of groundwater contamination. These activities are proposed to be conducted in parallel.

A review of existing information obtained from previous investigations has been undertaken and a summary is presented herein. This information includes chemistry data for groundwater and FOU soils, and subsurface information related to the geologic and hydrogeologic conditions at the Site. The existing information provides the basis for a presentation of the Site background, a conceptual geologic and hydrogeologic model, and potential fate and transport mechanisms.

The primary objective of the FFS is to provide an evaluation of remedial alternatives to enable selection by United States Environmental Protection Agency (USEPA) of a final remedy for FOU soils consistent with the National Contingency Plan (NCP). Five technologies have been retained for evaluation in the FFS: containment; hot spot removal; stabilization; bioremediation; and thermal desorption. The FFS approach, scope of work, organization and schedule are provided.

The primary objective of the Off-Property Investigation is to provide additional information regarding contaminant fate and transport within the till and bedrock aquifers. Investigative methods proposed include evaluation of groundwater use in the vicinity of the Site, long-term water level monitoring, installation of ten monitoring wells, including completion of a deep bedrock pilot hole, in-situ hydrogeologic testing, borehole geophysics, and groundwater sampling and analysis. The Off-Property investigation approach, scope of work, organization



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and schedule are provided. Details of the field and laboratory procedures are presented in appendices.

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## 1.0 INTRODUCTION

On behalf of the 216 Paterson Plank Road Cooperating PRP Group (Group), Golder Associates Inc. (Golder Associates) submits this Final Work Plan Amendment (Work Plan) for the next phase of work at the 216 Paterson Plank Road Site (Site) in Carlstadt, New Jersey. This document addresses Agency comments dated September 7, 1995 on the Work Plan Amendment dated June 19, 1995, in accordance with the Group's Response to Comments dated October 10, 1995 and subsequent Agency comments dated November 20, 1995. The June 19 Work Plan was submitted pursuant to the general outline provided in our letter dated February 21, 1995, and the subsequent comments from United States Environmental Protection Agency (USEPA) dated April 19, 1995.

The USEPA has requested that the Group complete a Focused Feasibility Study (FFS) for First Operable Unit (FOU) soils. An Off-Property Investigation (Investigation) to further evaluate the nature and extent of groundwater contamination is to be completed in parallel. This Work Plan provides the framework for the FFS and the Investigation, and describes the objectives, methodologies, schedule and organization. Administratively, the work is being conducted pursuant to the additional work provisions of an Administrative Order on Consent (Index No. CERCLA II-50114) dated September 30, 1985 (RI/FS Order).

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## **2.0 SITE BACKGROUND**

The 6-acre Site is a former chemical recycling and waste processing facility which ceased operation in 1980 and is located in a light industrial/commercial area of Carlstadt, New Jersey (Figure 1). The property is bordered to the southwest by Paterson Plank Road, to the northwest by Gotham Parkway, to the southeast by a trucking company, and to the northeast by Peach Island Creek. The Site was placed on USEPA's National Priorities List (NPL) in 1983.

The following sections provide a brief overview of the major remedial activities conducted at the Site to date.

### **2.1 Previous Studies**

A Remedial Investigation (Dames and Moore, 1990) was initiated in 1987 which evaluated soil and groundwater contamination beneath the Site. Borings were advanced at 30 locations during the remedial investigation and chemical analyses were performed on soil samples from 17 of these borings. In broad terms, the investigation revealed ground conditions comprising fill overlying a clay layer which was in turn underlain by glacial till and bedrock. Fourteen shallow piezometers (P-1 to P-14), and 7 shallow monitoring wells (MW-1S to MW-7S), were installed in the fill zone along with 3 deeper monitoring wells (MW-2D, MW-5D, and MW-7D).

An initial Feasibility Study for the FOU was conducted in 1989 by Environmental Resources Management, Inc. (ERM, 1989). The Feasibility Study evaluated remedial alternatives for FOU groundwater and soils/sludge. Treatability studies for soil and sludges were also conducted which included contaminant extraction testing, solidification and stabilization testing, and thermal treatment.

A total of 9 monitoring wells were installed off-property by Dames and Moore in 1989 pursuant to Project Operations Plan (POP) No. 8 (Dames and Moore, 1988). Five shallow

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monitoring wells were screened within the fill (MW-8S to MW-12S) and 4 deeper monitoring wells were installed (MW-8D, MW-11D, MW-12D, and MW-13D).

A deep bedrock monitoring well MW-2R was installed on the property by Dames and Moore in 1989 pursuant to POP No. 9 (Dames and Moore, 1988).

Dames and Moore excavated 23 test pits in July, 1989 to evaluate the nature of the fill material. The results are summarized in a report entitled Final Report - Excavation of Test Pits (Dames and Moore, 1989).

A Baseline Risk Assessment (BRA) was conducted by Clement Associates (Clement, 1990) for the USEPA. The BRA followed USEPA guidance for conducting risk assessments current at the time and utilized the information primarily collected during the initial phase of the RI.

## **2.2 1990 Record of Decision**

On September 14, 1990, USEPA issued a Record of Decision (ROD) selecting an interim remedy for a FOU at the Site based on the Remedial Investigation, Feasibility Study, and the BRA. The ROD defined the FOU as "contaminated soils and groundwater above the clay layer" and the selected remedy comprised the following elements:

- Installation of slurry wall around the entire Site;
- Installation of an infiltration barrier over the Site;
- Installation of a groundwater collection system and extraction of groundwater from the FOU zone; and
- Off-site treatment and disposal of extracted groundwater.

USEPA determined that the selected Interim Remedy would "reduce the migration of hazardous substances, pollutants and contaminants out of the first operable unit zone" and be "consistent with an overall remedy which will attain the statutory requirement for protectiveness."

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### 2.3 Interim Remedial Measures

The Interim Remedy was designed and implemented by the Group pursuant to an Administrative Order (Index No. II CERCLA - 00116) dated September 28, 1990. The Interim Remedy is illustrated in Figure 2 and consists of the following:

1. A lateral containment wall comprising a soil-bentonite slurry wall with an integral high density polyethylene (HDPE) vertical membrane which circumscribes the property;
2. A horizontal "infiltration barrier" consisting of high density polyethylene (HDPE) covering the property;
3. A sheet pile retaining wall along Peach Island Creek;
4. A groundwater extraction system for shallow groundwater consisting of 5 extraction wells screened in the fill which discharge to an above grade 10,000 gallon holding tank via an above grade header system; and
5. A chain link fence which circumscribes the Site.

The design of the Interim Remedy is presented in the Interim Remedy Remedial Design Report (Canonie, 1991) and construction was undertaken between August, 1991 and June, 1992. As part of the Interim Remedy design, 18 soil borings were conducted to evaluate subsurface conditions in the vicinity of the proposed slurry wall. The Interim Remedy construction is documented in the Final Report - Interim Remedy for First Operable Unit (Canonie, 1992).

The Interim Remedy has been in operation since June 1992 and extracted groundwater is regularly shipped, via tanker trucks, to the DuPont Environmental Treatment (DET) facility, located in Deepwater, New Jersey, for treatment and disposal. Between March 1993 and March 1994, the extraction system was not operational because of pump fouling by free phase product (Canonie, 1993).

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Maintenance and monitoring of the Interim Remedy is conducted pursuant to the USEPA approved Operations and Maintenance Plan (Canonie, 1991). Quarterly Operations and Maintenance reports are submitted to USEPA which contain the following:

1. Summary of groundwater extraction from the FOU;
2. Summary of Site inspections and maintenance activities;
3. Groundwater levels; and
4. Groundwater and surface water quality results from the quarterly sampling program.

The monitoring program currently consists of thirteen (13) groundwater monitoring wells as shown on Figure 2 and four (4) surface water sampling points in Peach Island Creek. In accordance with correspondence from USEPA dated June 30, 1995, samples are analyzed for Target Compound List (TCL) volatile organic compounds (VOCs) quarterly, and the Target Analyte List (TAL) and TCL compounds annually.

At the request of the landowner of an adjoining property, an additional monitoring well (RMW-13D) was installed in October 1995 in the approximate location shown on Figure 2; this well was installed as a potential replacement for well MW-13D, the location of which is unsatisfactory to the landowner. A decision regarding decommissioning of well MW-13D will be made following receipt of parallel groundwater quality data.

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### **3.0 SITE CONCEPTUAL MODEL**

#### **3.1 Regional Geology and Hydrogeology**

##### Regional Geology

The Site is situated in the Piedmont Lowland physiographic province of Bergen County and is underlain by interbedded sedimentary and igneous rocks of the Triassic-Jurassic age Newark basin. The Site is located in the northern portion of the glacially formed Hackensack valley, a broad, tidally influenced lowland bounded by the resistant ridges of sandy-siltstone and sandstone facies of the Passaic Formation (formerly the Brunswick Formation) to the west (beneath Kearny, North Arlington, Rutherford, East Arlington, and Carlstadt), and of the Palisades sill to the east which overlooks the Hudson River. The Hackensack River and its tributaries drain this lowland which is underlain by the less resistant sandy-siltstone and mudstone facies of the Passaic Formation (Parker, 1993). The regional geology is illustrated in Figure 3.

Unconsolidated deposits in this portion of Bergen County are related to the Wisconsin stage of the glaciation which reached its maximum extent approximately 20,000 years ago, during the Pleistocene Epoch (Stanford, 1993; and Averill et.al., 1980). The terminal Wisconsin moraine, which was located south of the Site, in Monmouth County, has influenced the development of the geologic conditions underlying the Site area. The dominant red and brown colors of these unconsolidated glacial deposits reflect their derivation from local bedrock which consists of the Watchung lavas, the Palisades sills, and red beds of the Newark Basin.

The Hackensack buried valley was scoured to a depth of approximately 250 feet below Mean Sea Level (MSL) and the valley axis is located several thousand feet west of the Site. The bedrock surface rises up from the axis of this buried valley to an elevation of 10 feet above MSL approximately one thousand feet east of the Site (Stanford et.al., 1990, Stanford, 1993). The bedrock surface beneath the Site is generally undulating and eroded

to an elevation of about 30 feet to 50 feet below MSL (Stanford et.al., 1990; Stanford et.al., 1995).

The glacial ice was as much as a thousand feet thick in this portion of New Jersey (Averill et.al., 1980). The glacial till deposited was generally a lodgment till which in most cases is largely derived from the local, underlying bedrock (Stanford et.al., 1993). The glacial till is quite varied in its thickness and lithology, and is generally thicker in the pre-glacial valleys occupied by glacial ice and thinner in the intervening areas.

Pre-glacial stream drainage was generally to the north and northeast. The stream valleys of the ancestral, preglacial Passaic, Hackensack and tributary streams were modified by glacial erosion and deposition, and locally blocked as the glaciers advanced south, forming glacial lakes. Two different lake levels have been recognized within the confines of the Hackensack valley. Glacial Lake Bayonne formed first and the deposits consist of yellow, reddish-brown and grey, varved siltstones and silty clays. Subsequently, Glacial Lake Hackensack formed about 15,000 years ago impounded behind the terminal moraine. The lacustrine sediments formed from Lake Hackensack deposits consist of reddish-brown, reddish-yellow, and grey, varved silts, silty-clays and clays. During the time the lake existed, locally up to 200 feet of varved lacustrine sediments accumulated. Along the margin of these lakes, coarser grained silts, sands, gravels and occasional boulders were shed into the varved sediments from the surrounding ridges and dropped by floating icebergs. Glacial Lake Hackensack drained into the Atlantic Ocean about 10,000 years ago when the terminal moraine was breached, leaving behind a vast featureless lowland (Stanford et.al., 1993).

About 4,000 years ago, rising sea levels converted the lowlands into a vast salt marsh and tidal-flat, drained by the Passaic, Hackensack and Rahway Rivers. The youngest sediments deposited consist of organic peat and vegetative matter set in a plastic clay/silt matrix. In the area of the Site, the lowland is part of the present day Hackensack Meadowlands drained by the Hackensack River, Berrys Creek and their tributaries



including Peach Island Creek. The Hackensack River is tidally influenced, has incised its channel into the underlying geologic units to as much as 10 feet below MSL, and flows within a meandering channel that drains south into the Newark Bay. Much of the present topography of the Hackensack valley has been modified by extensive industrialization, landfilling and reclamation, and is crossed by major roadways including the New Jersey Turnpike. The extent of development is seen in the varying thickness and composition of man-made fill overlying the area which can be as much as 40 feet thick.

#### Regional Hydrogeology

Groundwater in this part of New Jersey is obtained from bedrock and the overlying unconsolidated deposits. The unconsolidated deposits consist of both Recent and Holocene age fluvial deposits, and the underlying glacial deposits. Bedrock aquifers are generally confined by the overlying mantle of unconsolidated deposits. The fluvial deposits, and the glacial deposits form unconfined, semi-confined, and locally confined aquifers. The extent and thickness of discrete water-producing beds within the bedrock aquifer is generally controlled by secondary porosity such as joints, bedding planes and an assortment of other fractures. The hydraulic properties of the bedrock aquifers have been described in detail by Herpers and Barksdale (1951).

The glacial deposits are divided into stratified and unstratified deposits and can form productive aquifers. The glacial deposits consist of boulders, gravel, sand, silt, and clay largely derived from the local bedrock. Glacial tills when present generally serve as confining beds to the underlying bedrock. In deeper portions of the glacially scoured bedrock valley, glacial aquifers are developed in the pre-glacial valley fill deposits which consist of moderately- to well-sorted silts, sands and gravels, having been transported by glacial meltwater streams.

Overlying these older glacial deposits are the stratified glaciolacustrine sediments consisting of laminated (varved) clays, silts, very fine-grained sands and occasional gravel. The lacustrine sediments may be described as regional confining beds. Sand and gravel

deposited as deltas and fans in the glacial lakes may also locally overlie lake-bottom sediment, resulting in surficial, unconfined glacial aquifers. Recent age overbank flood plain silts and clays, and laterally discontinuous silts and clays of short-lived proglacial lakes may locally act as confining beds.

The surficial aquifers can produce substantial quantities of water, although by the early portion of the 20th century most of the production was curtailed due to degradation in water quality (Nichols, 1968; Herpers and Barksdale, 1951, Serfes, 1994; USEPA, 1995).

The groundwater present in the confined aquifers beneath the glaciolacustrine deposits (varved sediments) is generally under hydrostatic pressure and heads were as much as 10 feet to 40 feet above present ground surface in historical times (Herpers and Barksdale, 1951). Subsequently, extensive groundwater development and pumpage from these confined aquifers (both glacial and bedrock) has severely changed the groundwater flow directions and hydraulic heads. The potentiometric level for the bedrock aquifer now only rises to about 50 feet to 10 feet below MSL, depending upon the elevation of the bedrock-to-unconsolidated overburden interface.

Figure 3 provides a regional block diagram of the hydrogeologic units in the Hackensack lowlands in relationship to the Site. The data to develop this diagram was collected from available published reports and from previous investigations conducted at the Site.

### **3.2 Site Geology and Hydrogeology**

#### **Site Geology**

Subsurface information at the Site is mostly based on investigations conducted as part of the RI (Dames & Moore, 1990) and off-property monitoring wells installed subsequently.

The stratigraphy at the Site consists of the following units, from youngest to oldest:

1. Man-made fill;
2. Marine and Marsh Sediments;
3. Glaciolacustrine Varved Deposits;
4. Glacial Till; and

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## 5. Bedrock.

All subsurface units that directly overlie bedrock, including man-made fill are considered in this report as overburden. These overburden units are unconsolidated, and generally flat lying. A brief description of each geologic unit is provided below.

### **Fill Unit**

The unit directly underlying the Site consists of miscellaneous man-made fill material. The fill is about 3 feet thick near Peach Island Creek and increases to about 11 feet near Paterson Plank Road. At the Site, the miscellaneous fill consists of a mixture of soil, sand and gravel, and significant quantities of varying sizes of construction and demolition debris, asphalt, steel girders, wire, concrete blocks, bricks, timber, etc. The variable composition results in a highly erratic response to split spoon penetration as shown by the variation in the Standard Penetration Test (SPT) blow counts recorded as an "N" value. Typical N-values for miscellaneous fill ranged from 5 to as much as 146.

### **Marine and Marsh Unit**

A meadow mat of peat, organic silt and clay intermixed with sand is the youngest natural material underlying the Site. It forms a nearly continuous layer of variable thickness ranging from zero (at monitoring well MW-12D, and near the central portion of the Site), to as much as 7 feet near Peach Island Creek. The varying thickness of the peat layer may be due to uneven loading or placement of the fill, localized scouring by modern-day streams, or previous Site operations. SPT counts are highly variable, ranging from no penetration resistance to as much as 15 where sand stringers are present within the unit.

The base of the peat unit presents a sharp, well defined contact, with an organic grey fine-sand, and silt layer that is correlatable with similar deposits across the Hackensack and adjacent lowlands. The grey silt unit, with local paleosoils along its upper surface, is characterized by a uniform 2 feet thickness across the Site area. SPT blow counts range from 5 to as much as 23 in sandier portions or where it grades downward into gravel-

bearing interbeds. It is distinguished from the overlying peat unit by color and texture, and highly mottled character.

#### **Glaciolacustrine Varved Unit**

The grey silt unit overlies a glaciolacustrine varved unit. The boundary between these units is sharp, recognizable by a marked drop in the SPT blow counts. This unit can be subdivided into two units, an upper, varved clay and a lower, massive red clay unit. Based on a review of the regional geology, their elevations across the Site, and their lithologic character, these two units may be considered to be different facies of the glaciolacustrine deposits in the Hackensack lowlands. This unit is tentatively correlated with the varved silts, and silty clays of Glacial Lake Hackensack, although the lower portions may belong to the Glacial Lake Bayonne stage. It should be noted that the RI considered the massive red clay to be geologically part of the upper till; however, hydrogeologically it is considered part of the varved clay unit herein. The red clay will therefore be considered part of the varved clay unit herein.

The glaciolacustrine varved unit is a heterogeneous assemblage of massive to lean; plastic and very plastic; varved to laminated with silt and sand stringers, trace of gravel; mottled, reddish-brown, purple, red, reddish-grey, and yellow-brown silty clay and clay. It ranges in thickness from 8 feet (near Paterson Plank Road) to about 28 feet (near Peach Island Creek). At several locations, such as at MW-11D and MW-12D, a basal sand and gravel unit has been intercepted; and, at MW-2D, a local zone of silty-sand, with trace gravel was encountered in the middle portion of the glaciolacustrine varved unit. The SPT blow counts are typically lower than 10, with occasional highs of about 20 above siltier or sandier portions of the glaciolacustrine varved unit. The generally low blow counts, and lithologic character show that the glaciolacustrine varved unit is dominated by lean clays and silty clays.

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**Glacial Till Unit**

The glacial till unit has been defined in the RI (Dames & Moore, 1990) as having three distinct and separate members, clean sand, massive clay, and sand and gravel. The RI suggests that the heterogeneous mixture of sand and gravel forms the bulk of the till. However, additional subsurface information was obtained subsequent to the RI with the installation of the off-property wells. A review of the subsurface information now available, indicates an alternative interpretation of the geology may be made. This alternative interpretation is based on the SPT blow counts (which reflects the resistance offered by the geologic unit to a standard split spoon) together with the lithologic descriptions and review of the regional geology. First, as previously discussed, the massive clay and overlying clean sand is considered part of the glaciolacustrine varved unit. Secondly, much of the unit interpreted as till may be weathered bedrock or alternatively, lodgement till which is indistinguishable from weathered bedrock because of minimal downstream glacial transport. The SPT blow counts in each borehole log show a distinct and consistent increase in N-values (N=35 or greater, generally increasing to N=100 or as much as N=330) starting at a depth between approximately 35 to 55 feet below ground surface. In addition, the lithologic logs indicate the presence of shale and siltstone fragments within this zone. These distinguishing lithologic and penetration resistance features may represent a weathered bedrock unit, and not glacial till as originally interpreted (see Figure 4). The above relationships are evident from the borehole log for the new well RMW-13D (submitted to the USEPA on November 20, 1995). The glacial till intercepted in this off-property monitoring well occasionally displays SPT blow counts in excess of 100 but these probably reflect cobbles or boulders of rock larger than the split-spoon diameter. The presence of fragments of quartz, green mudstone and metamorphics shows that the lithologic unit is indeed an overconsolidated glacial till. These observations are supported by published literature (Averill et.al., 1980, Argon, 1980; and Stanford et.al., 1993) which classify the glacial tills in this part of New Jersey to be of subglacial, or lodgment origin developed beneath a large thickness of glacial ice.

Informally correlated with the Rahway Till, the Glacial Till unit consists of a heterogeneous mixture of red, yellow-brown, reddish-brown, and reddish-grey clay, silt, sand, and gravel. The color and overconsolidated nature gives the glacial till a character relatively indistinguishable from weathered bedrock. However, on detailed examination, the lithologic character sets the glacial till apart from the underlying weathered bedrock.

The alternative interpretation of the borehole logs is significant because the thickness of the glacial till is reduced and a weathered bedrock zone is identified within which existing monitoring wells are screened or partial screened. This alternative interpretation will be confirmed during additional investigations proposed during the implementation of this Work Plan.

#### **Bedrock Unit**

The bedrock unit underling the Site consists of a red siltstone and shale interbedded with red-brown sandstone. Only one borehole, MW-2R, was advanced through relatively competent bedrock from a depth of approximately 57 to 88 feet below ground surface. The bedrock was noted to be highly fractured throughout.

Based on the alternative interpretation described above, this bedrock zone is overlain by a highly weathered bedrock unit with a thickness on the order of 15 to 20 feet. This zone is characterized by consistently very high N-values and the presence of shale or siltstone fragments.

#### **Site Hydrogeology**

Groundwater at the Site may be considered in terms of two separate aquifers separated by a confining unit. The surficial, or shallow aquifer unit consist of the man-made fill, the peat unit, and the grey silt unit which together overlie the glaciolacustrine varved unit. The deeper aquifer is developed in the glacial till (Rahway Till), the weathered bedrock and intact bedrock. The deeper aquifer is confined by the glaciolacustrine varved unit.

Groundwater flow in surficial aquifers of this type is generally radial from topographic highs, discharging to nearby natural streams or drainage ditches. In geologic conditions such as those present at the Site, the groundwater surface in the shallow aquifer would generally be a subdued image of the topography. However, in the vicinity of the Site, the slurry wall, sheet pile wall, and local pumping of the shallow groundwater aquifer has greatly modified groundwater flow direction, gradients and recharge.

Groundwater flow in the surficial aquifer at the Site area appears to be generally to the southwest towards Paterson Plank Road as indicated by water level measurements of piezometers screened in the fill. The elevation of the groundwater is higher along the northwestern and eastern portions of the Site area (ranging from 4 feet to 6 feet above MSL), and sloping towards Paterson Plank Road where the elevations are about 2 feet above MSL. This apparent anomaly in the shallow groundwater flow direction, indicating flow away from Peach Island Creek (see Figure 4) may be a result of local pumping of the shallow aquifer in the area of the Meadowlands and arena south of Paterson Plank Road (Dames and Moore, 1990).

The off-property investigation described in this Work Plan is designed to provide information which will particularly assist in understanding the hydraulic regimen in the deeper aquifer. Groundwater flow in bedrock such as the Passaic Formation is generally controlled by secondary porosity, in this case fractures, joints, and bedding planes. In bedded strata, groundwater flow may be controlled by bedrock strike or dip. However, local pumping of the deeper aquifer in surrounding areas, as suggested in the RI, may have caused changes in groundwater flow directions. The geologic conditions, stratigraphic boundaries, particularly the elevation of the top of bedrock, will be verified during the Investigation and will supplement the existing monitoring wells in assessing groundwater characteristics of the deep aquifer.

Several of the monitoring wells installed (e.g., MW-8D and MW-13D) in the deep aquifer units straddle hydrogeologic unit boundaries. In other words the screen straddles either the weathered bedrock-till interface or glaciolacustrine varved unit-till interface. The proposed

additional investigation and reassessment of available hydrogeologic data, together with discretely screened monitoring wells should assist in better defining the hydraulic character of the glacial till, weathered bedrock, and intact bedrock hydrogeologic units which together comprise the deeper aquifer.

### **3.3 Contaminant Fate and Transport**

The RI data indicated that the on-property fill materials are impacted by a variety of contaminants including volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs) and metals. VOCs are also present in the shallow groundwater within the fill, in some cases at concentrations exceeding 10% of solubility for compounds such as tetrachloroethylene (PCE) and trichloroethylene (TCE). These concentrations are consistent with the presence of free phase product in the fill as physically observed in the field. Groundwater within the fill is laterally contained by the slurry wall and the aqueous phase is being extracted and treated as part of the Interim Remedy. Based on quarterly water level data, inward gradients are generally indicated across the slurry wall, except for along Peach Island Creek, where the gradient is towards the Creek

Groundwater in the till and potentially bedrock is also impacted and is considered to be a potential off-property pathway for Site related constituents. Contaminants, particularly VOCs, have been detected in groundwater monitoring wells both on- and off-property based on the quarterly monitoring results. The groundwater chemistry is further detailed in Section 5.2.

An understanding of the area-wide transport mechanism(s) of contaminants to the till and bedrock, and subsequent transport within the till and bedrock is essential to developing a conceptual framework within which remedial alternatives may be evaluated.

Water levels indicate that downward hydraulic gradients are prevalent throughout the Site and likely contribute to the downward migration of contaminants. However, the glaciolacustrine varved unit separating the fill from the till is on the order of 15 feet thick, is described as a predominantly clay soil, and has a hydraulic conductivity on the order of  $10^{-7}$  cm/sec based on



RI data. Such a unit would be expected to act as an effective barrier to migration of contaminants; therefore, it is possible that additional mechanism(s) play a role in the transport of contaminants. Potential mechanisms/contributing factors include:

- Migration through the glaciolacustrine varved unit, in particular via fractures and sand/gravel stringers,
- Deterioration of the well seals, particularly in the presence of free-phase product;
- Physio-chemical degradation of the clay matrix/particles of the glaciolacustrine varved unit in the presence of free-phase product;
- Utility trenches which may have been excavated into the varvite;
- An on-site well or other glaciolacustrine varved unit penetration related to past operational practices (based on depositional testimony from a former Site worker, a water supply well existed on the Site at one time, although its location cannot be established);
- Upgradient source(s); and
- Groundwater extraction from the till and bedrock in the Site vicinity for industrial use.

Further assessment and identification of the contaminant transport mechanisms to, and within the till and bedrock will be a major focus of the Investigation.

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#### **4.0 FOCUSED FEASIBILITY STUDY**

##### **4.1 FOU Soils Chemistry**

The present analytical database for FOU soils is contained within the Remedial Investigation Final Report (Dames and Moore, 1990). Soil samples from the FOU were collected at 17 locations at depths from 0 to 2 feet (unsaturated fill) and 5 to 6 feet (saturated fill) as shown on Figure 5. As noted in the RI, soil sample locations were biased toward areas where organic and inorganic compounds were most likely to be detected based on Site history, geophysics and visual observations. It should also be noted that analyses of saturated soil samples taken from below the water table will be biased high for certain compounds by virtue of groundwater contamination. A variety of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, PCBs, and inorganics were detected in FOU soils as detailed in Tables 1a and 1b.

It should be noted that the Interim Remedy has significantly modified the top 2 feet of the Site since the RI sampling was conducted. Specifically, spoils from excavation of the slurry wall and waste slurry were disposed on the ground surface and previous topographic features were regraded. Therefore, additional sampling may be required to evaluate current conditions prior to remedy selection.

##### **4.2 Preliminary Remediation Goals and Remedial Action Objectives**

The USEPA provided an initial list of Preliminary Remediation Goals (PRGs) to the Group in a letter dated November 19, 1993. The initial list of PRGs is largely based on the methodologies presented in USEPA guidance (USEPA, 1989) which assumes industrial/commercial use of the Site (except in the case of lead); conservative dermal contact, ingestion, and inhalation exposure routes; a  $1 \times 10^{-6}$  excess cancer risk and a Hazard Index of 1 for non-carcinogens. Golder Associates' February 21, 1995 scoping letter presented an evaluation of the initial list of PRGs in order to refine the PRGs for the purposes of the FFS as suggested in USEPA guidance. This refinement considered the results of the BRA, updated toxicity information and Site specific concentration data. A comparison of maximum detected concentrations of

chemicals in soil to the initial PRGs is shown in Tables 1a and 1b. Based on this assessment (with which USEPA has concurred) the PRGs are retained for the following chemicals for the purposes of evaluating alternatives in the FFS for FOU soils:

- aldrin;
- arsenic;
- carcinogenic PAHs;
- dieldrin;
- lead;
- PCBs;
- tetrachloroethylene (PCE); and
- trichloroethylene (TCE).

It should be noted that the maximum detected concentration for lead exceeds the initial PRG. However, the initial PRG is based upon a residential use scenario which is not applicable to the Site, and the BRA did not assess Site specific risks based on lead. A Site specific risk evaluation for lead, based on industrial site use, may be proposed if lead is a critical compound in the assessment of effectiveness of any alternatives in the FFS.

As noted in Golder Associates' February 21, 1995 scoping letter, the present numerical PRGs for these compounds will likely require refinement in order to develop clean-up goals.

Based on the above listed PRGs, the preliminary remedial action objective for FOU soils is to prevent direct contact exposure (dermal exposure, ingestion, and inhalation routes) to FOU soils containing constituents above the PRGs. This preliminary remedial action objective will be refined during the FFS.

#### **4.3 Scope of Work**

The Group presented to the USEPA in March, 1994, nine remedial technologies for potential application to the Site. As requested by USEPA in a meeting on December 22, 1994, these technologies were reviewed and reduced to the following five technologies as presented in Golder Associates' letter dated February 21, 1995.

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1. Containment
  2. Hot Spot Removal
  3. Stabilization
  4. Bioremediation
  5. Thermal Desorption

The FFS will be conducted in a phased approach consistent with the NCP and USEPA guidance (USEPA, 1988) but will focus on the above technologies as agreed with USEPA. In addition, the FFS will be based upon the premise stated in the 1990 ROD that the overall remedy must be consistent with the Interim Remedy. The approach will include further screening of these technologies and development of remedial alternatives to implement them, performance of additional sampling/treatability studies if necessary, and a detailed analysis of retained alternatives. This approach is discussed in the following sections.

#### **4.3.1 Development of Alternatives**

This phase of the FFS will provide an evaluation of the retained technologies listed above and will serve as the basis for developing remedial alternatives to implement them for detailed evaluation. The technologies will be evaluated and alternatives assembled based on effectiveness, implementability, and cost in accordance with the USEPA RI/FS guidance (USEPA, 1988). The previous treatability studies conducted both as part of the initial FS and subsequently by USEPA will be considered in the evaluation process. In addition, the various forms of each technology, including in-situ and ex-situ applications and variants such as bioventing/SVE and dual-phase extraction will be considered where appropriate.

The Interim Remedy selected in the 1990 ROD for the FOU included containment of the soils and groundwater as well as the extraction of groundwater from the FOU. The FFS will consider alternatives which are consistent with the Interim Remedy recognizing that the Interim Remedy has already addressed certain exposure pathways. In particular, containment alternatives will focus on enhancements to the existing Interim Remedy components.

The effectiveness evaluation criterion focuses on the potential effectiveness of the technology to meet the remedial action objective(s) for the estimated volume of material; the potential

impacts to human health and the environment during the construction and implementation phase; and the reliability of the technology with respect to the contaminants and conditions of the Site. Technologies that are not capable of meeting the remedial action objectives will be screened out.

The implementability criteria includes the technical and administrative feasibility of implementing a technology. The technical implementability criteria is used to screen technologies which cannot be effectively implemented based on the nature of contaminants or site conditions. The administrative feasibility relates to the institutional aspects such as permitting, off-site disposal options, and availability of necessary equipment. Technologies which are considered technically or administratively infeasible to implement due to Site conditions will be screened out.

Technologies will also be evaluated based on relative capital as well as operation and maintenance costs. The cost analysis will be based primarily on engineering judgment and will enable comparisons to be made between technologies. Technologies will be eliminated if the costs are estimated to be greater than another equally effective and implementable technology.

It should be noted that stabilization, bioremediation and thermal desorption may be evaluated both as "hot spot" remedies and for application to the entire FOU. An evaluation of existing chemistry data will be conducted during this initial phase to assess the distribution of the chemicals retained on the PRG list. Discrete areas may be considered "hot spots" if the area is large enough and the nature and concentration of constituents are such that focused remediation will be effective in significantly reducing the overall risk, but small enough to consider separately as an adjunct to or in place of remediation of the entire FOU. Physical characteristics of the materials (e.g., sludge vs. soil) may also be considered in evaluating potential "hot spots". Hot spot removal alternatives may include excavation of fill, removal of non-aqueous phase liquids (NAPL), and vapor via dual-phase extraction.

Alternatives for detailed analysis will be developed and scoped based on the evaluation of technologies described above. A meeting will be held with the Agencies at the end of this

phase to discuss the retained alternatives. In accordance with the NCP, a No Further Action Alternative will be retained for detailed analysis.

#### **4.3.2 Sampling/Treatability Studies**

Based on the evaluation of technologies during the initial phase, additional Site characterization and/or treatability studies may be warranted to supplement existing information to support final scoping and detailed analysis of alternatives and reduce uncertainties in the subsequent detailed analysis. If additional data is determined not to be necessary, the rationale will be discussed at a meeting with the Agencies as described in Section 4.3.4. If additional data is necessary to confirm the effectiveness of a technology or evaluate costs on a site specific basis, the rationale, general approach, and schedule will be discussed at the meeting to obtain Agency concurrence. It is envisioned that a detailed scope of work for any sampling/treatability work will be submitted to the Agencies following the meeting and prior to initiating data collection activities.

#### **4.3.3 Detailed Analysis of Alternatives**

A detailed analysis of the retained alternatives selected will be performed to facilitate Agency selection of the most appropriate remedy for FOU soils. The alternatives will be analyzed in accordance with the NCP evaluation criteria listed below:

1. Overall Protection of Human Health and the Environment;
2. Compliance with ARARs;
3. Long-Term Effectiveness and Permanence;
4. Reduction of Toxicity, Mobility, and Volume;
5. Short-term Effectiveness;
6. Implementability; and
7. Cost.

The NCP also requires evaluation of State and Community acceptance of each alternative; of necessity, this evaluation is largely made by USEPA following public comment on a Proposed Remedial Action Plan.

As part of the long-term effectiveness evaluation, the post-remedial risk will be estimated for each alternative. The general methodology for estimating post-remedial risk, as presented in Golder Associates' February 21, 1995 letter, will include the following:

- a. Post remedial risk for each alternative may be estimated by simply modifying the Reasonable Maximum Exposure (RME) concentration in the BRA, since the toxicity and exposure aspects of the risk calculation will be essentially the same.
- b. For "hot spot" removal or containment remedies, the RME should be recalculated, excluding data points from the removal or containment zones.
- c. For thermal desorption and bioremediation remedies, the RME should be recalculated based on expert estimates of compound specific Destruction Removal Efficiencies (DRE) for each technology.
- d. For stabilization remedies, the RME should be recalculated based on expert estimates of effectiveness. Since stabilization essentially immobilizes, rather than destroys, contaminants, quantitative estimates will be based on expert assessments of reduced bioavailability in relation to direct contact exposure routes.

As requested by USEPA, the FFS will consider residual risk management strategies for the Site consistent with post-remedial industrial or commercial use of the property.

In order to reflect the potential impact of the known heterogeneity of the FOU soils, cost estimates may be presented as ranges. If appropriate, the probability distribution of costs within the range may be assessed to permit comparative analysis of alternatives.

A comparative analysis of alternatives will be conducted to evaluate the relative performance of the alternatives against each other in relation to each of the NCP evaluation criteria. This analysis will include assessment of the cost-effectiveness of each alternative in terms of the risk reduction achieved relative to the cost.

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#### **4.3.4 Meetings/Reporting**

Various meetings are proposed throughout the FFS process to maintain a high level of communication with the Agencies, and provide a forum for Agency participation throughout the study. A kick-off meeting is proposed with the Agencies prior to commencing the screening of technologies and development of alternatives. The purpose of this meeting is for the Agency representatives to meet with the FFS team to conceptually discuss the technologies under consideration and the objectives of the FFS. A second meeting is proposed with the Agencies once the remedial alternatives have been developed. The purpose of this meeting is to reach consensus on the alternatives retained for detailed analysis and to develop the scope and schedule for any additional sampling/treatability studies required. Additional meetings or conference calls will be held as necessary throughout the FFS.

A Draft FFS Report will be submitted to the Agencies following detailed analysis of the alternatives. It is anticipated that the substantive features of the report will have already been discussed with the Agencies through meetings or conference calls prior to the submittal which will facilitate and expedite the review and comment period. A Final FFS Report will incorporate modifications based on Agency comments.

The Group strongly believes that a high level of communication and Agency participation throughout the FFS process is important in developing a sound, cost-effective remedy in a timely manner.

#### **4.4 FFS Organization**

Figure 6 presents the Organization Chart for the FFS. The USEPA Case Manager, Richard Puvogel, will coordinate with the New Jersey Department of Environmental Protection (NJDEP) Case Manager, Riché Outlaw, and serve as the primary contact with the Facility Coordinator, Steve Finn of Golder Associates. The Facility Coordinator will provide overall management of activities related to the FFS and coordination between the Agencies and the Group. Mr. Finn will be assisted by Robert Illes within Golder Associates.



In view of the physical and chemical complexities of the Site and the need to carefully evaluate the potential impact of the resulting uncertainty of each alternative, the Group will retain the services of expert consultants for each major technology under consideration. The experts currently under consideration are as follows:

**Stabilization - Jesse Conner (Conner Technologies)**

**Bioremediation - Mary DeFlaun, Ph.D (Envirogen, Inc.)**

**Thermal Desorption - Carl Swanstrom (Argonne National Laboratory)**

The FFS Manager at Golder Associates (Randolph S. White, P.E.) will be responsible for the technical aspects of the FFS and coordinating the FFS team of experts. Mr. White has 14 years experience including managing several CERCLA Feasibility Studies in USEPA Regions 2 and 3.

Resumes for each of the team members are included in Appendix A.

#### **4.5 Schedule**

The proposed schedule for the FFS is presented on Figure 7a. The 12 to 17 month schedule begins with the initial submittal of this Work Plan and ends with the submittal of the Final FFS Report. The schedule provides for a one-month Agency comment period on this Work Plan followed by a one-month Group response period for finalizing the Work Plan. The 10 to 15 month period to complete the FFS will commence upon Agency approval of the Work Plan.

A 3-month period is allotted for evaluating the 5 technologies and assembling alternatives. Early in this phase, the kick-off meeting will be held with the Agencies. This phase of the FFS will end with a second meeting with the Agencies to discuss the remedial alternatives proposed for detailed analysis. A 5-month contingency is included in the 15 month schedule for additional sampling/treatability studies, if required. Since the scope of any additional sampling

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and treatability studies cannot be determined at this time, the actual duration may vary and will be agreed upon with USEPA once the scope of work is determined. A 4-month period is allotted to conduct a detailed analysis of alternatives and submit a Draft FFS Report. A 3-month comment/response period is envisioned following submittal of the Draft FFS Report which includes a 1-month Agency review period and a 2-month response period and submittal of the Final FFS Report.

It should be noted that a 15 day response period to finalize the Feasibility Study is indicated in the RI/FS Order following receipt of Agency comments. In compliance with this requirement, a meeting or conference call will be held with the Agencies within 15 days of receipt of comments to agree on modifications to the FFS based on Agency comments. Following the meeting or conference call, it is envisioned that red-lined revisions of the report will be provided to the Agencies. The Final FFS Report will be submitted once the red-line changes have been approved by USEPA. This approach is expected to provide the most efficient and timely completion of the FFS.

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## **5.0 ADDITIONAL OFF-PROPERTY INVESTIGATION**

### **5.1 Investigation Objectives**

Previous on- and off-property investigations indicate that groundwater is contaminated in the till and possibly the bedrock. These two aquifers underlie the glaciolacustrine varved unit (a confining unit) ranging in thickness from 8 to 28 feet thick (as discussed in Section 3.2). The mechanism for contaminant transport to and within the till and bedrock is not adequately understood. Therefore, the objective of this off-property investigation is to further examine the nature and extent of deep groundwater contamination via installation and monitoring of additional wells screened within the till and bedrock. The proposed program will enable evaluation of the off-property groundwater quality and groundwater flow direction within each of the deeper aquifers.

During implementation of the Investigation, detailed sampling of the unconsolidated sediments and the bedrock (split spoon and rock coring) will be conducted to obtain information on the stratigraphy and depth to bedrock. In-situ hydrogeologic testing (slug tests and packer testing) will be conducted in each well to obtain information on the aquifer characteristics of the till and bedrock. Borehole geophysics will be conducted in select existing monitoring wells to investigate possible contaminant transport mechanisms (e.g., poor grout seal integrity) in addition to providing additional information on the subsurface geology and hydrogeology. Information collected from the Investigation will be used to refine the conceptual geologic and hydrogeologic model for the Site to better understand:

- Nature and extent of groundwater contamination;
- Contaminant transport mechanisms; and,
- Groundwater flow directions.

The proposed monitoring well locations are shown in Figure 8 and the scope of work for the off-property field investigation is described in Section 5.4.

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## 5.2 Groundwater Chemistry

Groundwater quality is monitored quarterly in existing wells pursuant to the requirements of the Operation and Maintenance Plan (O & M) for the Site Interim Remedy (Canonie, 1991). Each monitoring well is sampled and analyzed for TCL and TAL constituents annually and TCL VOCs quarterly. Referring to Figure 2, five off-property shallow wells (MW-8S, MW-9S, MW-10S, MW-11S, and MW-12S) monitor the fill on the west, south, and east sides of the Site. Three on-property wells (MW-2D, MW-5D, and MW-7D) and four off-property wells (MW-8D, MW-11D, MW-12D, and MW-13D) monitor groundwater quality in the till/weathered bedrock. A single bedrock well (MW-2R) is located on-property.

A summary of the sampling results through the tenth round (July 1995) of O&M groundwater monitoring (including groundwater results prior to implementation of the Interim Remedy) is discussed below. It should be noted that the ninth and tenth sampling events were only analyzed for VOCs, in accordance with a letter dated June 30, 1995 from USEPA.

### Volatile Organic Compounds

A summary of total volatile organic compound concentrations detected in each sample for all sampling events is summarized in Table 2. Volatile organic compounds (VOCs) have generally not been detected in samples from the off-property fill monitoring wells with no detections in the April 1994, January 1995, and April 1995 sampling events and sporadic low level detections of single compounds in the July 1995 sampling event. VOCs have been detected consistently in the till/weathered bedrock monitoring wells and the single bedrock well. Total 1,2-dichloroethene, 1,1-dichloroethene, 1,1,1-trichloroethane, chloroform, trichloroethene, and tetrachloroethene have been the most commonly detected VOCs.

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#### Semi-Volatile Organic Compounds

Semi-volatile organic compounds (SVOCs) have generally not been detected in any of the monitoring wells with the exception of wells MW-9S and MW-11D where low concentrations have consistently been measured. Total SVOCs detected in sample MW-9S ranged in concentration from 12 ppb to 85 ppb. Acenaphthene, dibenzofuran, fluorene, 2-methylnaphthalene, naphthalene, and phenanthrene are the commonly detected SVOCs for MW-9S. Total SVOCs detected in sample MW-11D generally ranged in concentration from 7 ppb to 38 ppb (excepting an anomalous value of 317 in April 1994). 1,2-dichlorobenzene, 4-methylphenol, naphthalene, 2-methylnaphthalene, phenanthrene, and bis (2-ethylhexyl) phthalate (a common laboratory/sampling contaminant) are the commonly detected SVOCs for MW-11D.

#### Pesticides/PCBs

Only one pesticide compound was detected in samples collected during the February 1989 groundwater sampling event (MW-8S) and none were detected in the subsequent seven groundwater sampling events. Very low level detects for pesticides were reported in a few samples from the January 1995 sampling event. However, as discussed in the April 1995 Quarterly Operation and Maintenance Report, these apparent detects result from a literal interpretation of the CLP Statement of Work by a different laboratory and are not considered relevant.

PCBs have been detected in samples from two monitoring wells; Aroclor 1242 has been consistently detected in MW-11D at concentrations ranging from 9 ppb to 56 ppb and Aroclor 1232 was detected once in MW-5D at a concentration of 1.8 ppb in the December 1987 sampling event.

#### Inorganics

A wide range of inorganics have been consistently detected in each of the fill, till, and bedrock monitoring wells including naturally occurring compounds. In general, the

inorganic concentrations are highest in the fill. In at least some cases the inorganics detected may be indigenous compounds present at background levels.

### **5.3 Groundwater Use**

The objectives of investigating groundwater use in the vicinity of the Site area are:

- To confirm that groundwater is not being used locally as a potable water source; and,
- To determine if there is any significant groundwater pumping in the area (for industrial or other uses) which may affect groundwater flow directions.

Information on water usage in the area will be summarized from a survey of available records at the Bureau of Water Allocation of the NJDEP. In addition, the Bureau of Water Allocation records will be obtained for wells with permits to withdraw more than 100,000 gallons per day, within a one mile radius of the Site. A request has also been made to NJDEP for any water use information which may have been obtained through studies conducted at other remediation sites in the vicinity. If needed, residences and businesses within an approximate 1/2-mile radius of the Site will be contacted via a letter or phone call requesting that each residence/business complete a well inventory form for verification purposes.

All information obtained will be summarized in the report with a detailed map indicating identified well locations and a table summarizing all available details regarding well construction, pumping rates, and well usage.

### **5.4 Scope of Work**

The Scope of Work for the Investigation includes the following:

1. Long-term water level monitoring;
2. Completion of one deep bedrock pilot boring;
3. Installation of ten (10) monitoring wells;
4. Hydrogeologic testing;
5. Borehole geophysical testing; and
6. Groundwater quality sampling.

The following Sections generally describe each task to be performed. Detailed procedures to perform the field work are described in the Sampling, Analysis, and Monitoring Plan (SAMP) provided in Appendix B. Quality assurance and data validation procedures are discussed in the Quality Assurance Project Plan (QAPjP) provided in Appendix C. All field work will be conducted in accordance with the Health and Safety Plan (HASP) provided in Appendix D.

#### **5.4.1 Water Level Monitoring**

The objective of the water level monitoring is to evaluate the effects of both tidal influences from Peach Island Creek and potential nearby groundwater pumping on water levels within the till and bedrock. This information will be important in evaluating groundwater flow directions and assessing contaminant fate and transport.

The Remedial Investigation (Dames & Moore, 1990) included an evaluation of long term water levels in monitoring wells MW-5S (screened across the water table) and MW-5D (screened within the till and bedrock), and Peach Island Creek. Conclusions from this study indicated that the water table aquifer responds quickly to precipitation events but does not respond to the tidal fluctuations experienced by Peach Island Creek. Groundwater levels within the till aquifer were shown to fluctuate in response to nearby pumping well(s) and tidal influences. However, since only one well screened within the till was evaluated during the Remedial Investigation, it is not possible to evaluate if the changes in the water elevations would have an effect on the direction of groundwater flow.

To further evaluate the magnitude of these changes and how they may affect groundwater flow direction, a total of ten monitoring wells (MW-2R, MW-2D, MW-5D, MW-7D, MW-8D, MW-8R, MW-10R, MW-11R, MW-12D, and MW-14R) and Peach Island Creek (SWM-1) will be continuously monitored for approximately two months (for locations see Figure 8). Water level monitoring procedures are described in Appendix B.

Information on pumping schedules, rates, and quantity of withdrawal obtained from industrial users (see Section 5.3) will be used to compare the effects of such pumping on the hydrogeologic conditions of the Site during the long-term monitoring.

#### **5.4.2 Pilot Bedrock Borehole**

One deep bedrock pilot boring will be completed to approximately 50 feet into competent bedrock to provide detailed geologic and hydrogeologic characterization of the bedrock in the vicinity of the Site. Drilling of the pilot boring will be curtailed if free-phase NAPL is encountered which could contaminate the deeper bedrock. The pilot borehole will be completed at location MW-8R (Figure 8). This well will be subject to the following testing:

- Detailed logging of rock core lithology and fracturing;
- Straddle packer testing of each distinct unit based on lithology and/or fracturing. Packer testing data will be interpreted to provide hydraulic head data and hydraulic conductivity; and,
- Geophysical testing comprising temperature log, caliper log, and downhole velocity survey.

General descriptions of drilling, hydrogeologic testing and geophysical testing are provided in the following sections and are further detailed in Appendix B.

#### **5.4.3 Monitoring Well Installation and Development**

A total of four wells screened within the till/weathered bedrock, four wells within competent bedrock, and one well each in the till and weathered bedrock are proposed at off-property locations shown on Figure 8. The objective of these monitoring wells is to provide groundwater quality and elevation data within the till and bedrock aquifers at specific locations around the Site where information is not available.



Monitoring wells MW-10D, MW-14D, MW-15D, and MW-16D will be screened within the till/weathered bedrock unit and monitoring wells MW-8R, MW-10R, MW-11R, and MW-14R will be completed within the competent bedrock as open holes in accordance with NJDEP bedrock monitoring well guidelines. The bottom portion of the pilot bedrock hole, MW-8R, will be grouted and the upper zone of competent bedrock screened. Two monitoring wells, MW-17D (till) and MW-18D (weathered bedrock), will be installed adjacent to proposed bedrock monitoring well MW-8R. These monitoring wells will be utilized to monitor differences in head and groundwater quality between the till, weathered bedrock, and competent bedrock. Double casing will be used for each well to minimize the possibility of cross-contamination. Monitoring wells will be constructed using stainless steel materials (except the open bedrock wells) and will be completed as flush mount wells.

At each bedrock well location the unconsolidated sediments will be continuously sampled using a split spoon sampler and the bedrock will be cored. This detailed sampling will provide additional data on the subsurface geology which will be utilized to update the Site conceptual geologic model.

The till/weathered bedrock wells will be screened within the most contaminated zone based on PID readings and visual observations during drilling. If no elevated readings and/or visual contamination is observed, the most permeable zone (based on visual assessment of split spoon samples) will be screened with a maximum screen length of 10 feet. At the cluster formed by MW-17D and MW-18D, the same general approach will be used while ensuring that the upper (MW-17D) screen is solely in till and the lower (MW-18D) screen is solely in weathered bedrock. Bedrock wells will be drilled 20 feet into competent rock (based on core descriptions) and casing will be set in the upper 10 feet (in accordance with NJDEP bedrock monitoring well installation guidelines), creating a 10-foot monitoring zone in the upper zone of the competent bedrock. The pilot bedrock hole will extend 50 feet into competent bedrock. Therefore, the bottom 25 to 30 feet will be grouted in order to create a 10-foot monitoring zone in the upper zone of the competent

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bedrock. Drilling and well installation procedures are described in detail in Appendix B, Sections 2.2 and 2.3.

All monitoring wells will be developed in accordance with the New Jersey Field Sampling Procedures Manual (May 1992) and Monitoring Well Development Guidelines for Superfund Project Managers (April 1992), as described in Section 2.3 of Appendix B.

#### **5.4.4 Hydrogeologic Testing**

Hydrogeologic testing in each of the proposed wells will be performed to obtain hydrogeologic characteristics of the till/weathered bedrock and bedrock aquifers. Estimates of horizontal hydraulic conductivity, hydraulic head, and potential groundwater flow zones will be obtained by conducting packer tests in each of the bedrock pilot corehole MW-8R and the cored boreholes at locations MW-10R, MW-11R, and MW-14R.

The testing of the bedrock pilot corehole will be conducted using a double packer assembly with a distance of approximately 10 feet between packer glands. A single packer configuration will be utilized for testing the lowest interval in the corehole. This corehole is proposed to be drilled 50 feet into competent bedrock. As a result, four to five packer tests are expected to be completed depending on the corehole integrity and fracturing/flow zones. Individual test zones will be selected based on fracturing data from the core and the results of the downhole flow velocity logging.

The bedrock wells MW-10R, MW-11R, and MW-14R are proposed to be drilled 20 feet into competent bedrock. The upper 10 feet will be cased (using a 4-inch steel casing) to avoid any potential cross contamination from the upper hydrostratigraphic units. The lower 10 feet will be tested using a single packer configuration. The packer gland will be set on the permanent casing (4-inch casing).

The packer assembly that will be used for the hydrogeologic testing program includes a shut-in valve that allows instantaneous flow in or out of the test zone (flow phase of the test). In addition, the shut-in valve can instantaneously isolate the test zone from any external stress (shut-in or recovery phase of the test). The implementation of variable head testing (flow phase) followed by recovery (shut-in phase) is expected to provide data for the characterization of the aquifer properties and type of flow system (homogeneous, dual porosity, dual permeability, or composite flow). During the flow period, variable head tests (rising or falling) will be completed. This phase of the test will be analyzed with appropriate methods which will include: Hvorslev (1951), Bouwer and Rice (1976), or Papadopoulos and Cooper (1967). The recovery phase data will be analyzed with Horner method (1977). The diagnosis of flow regime will be made by using the semilog derivative of the hydraulic head data (Bourdet et.al., 1989; Ostrowski et.al., 1988).

If high hydraulic conductivity conditions are encountered in bedrock wells MW-10R, MW-11R, and MW-14R, the permanent 4-inch casing above the packer will be used to produce the variable flow rather than the smaller diameter drilling rods, so as to provide greater measurement precision.

The detailed packer testing procedures are described further in Appendix B, Section 3.3 and Attachment B4.

Estimates of horizontal hydraulic conductivity will be obtained by conducting rising and falling head tests (slug tests) in monitoring wells MW-10D, MW-14D, MW-15D, MW-16D, MW-17D, and MW-18D. The data collected will be used in conjunction with the water levels and hydraulic gradients to refine the conceptual hydrogeologic model for the Site. The slug test procedures are described further in Appendix B, Section 3.3.2.

#### **5.4.5 Geophysical Testing**

Borehole geophysical testing will be performed on a number of existing monitoring wells and on the proposed bedrock pilot corehole.

The purpose of the borehole geophysics on existing wells is to potentially provide information on the grout integrity of existing on-site wells screened in the till and bedrock. Poor grout integrity could be a mechanism for contaminant transport from the water table aquifer to the underlying till and bedrock aquifers on-site. Geophysical testing comprising natural gamma and acoustic (cement bond) logging as appropriate will be performed on wells MW-2D, MW-2R, MW-5D, and MW-7D and several of the newly installed off-property wells. Geophysical testing on the newly installed wells will provide a 'standard' to compare with the data collected from the existing wells. The data collected from the borehole geophysics is also expected to provide some confirmatory information on the stratigraphy and depth to bedrock. Existing wells will also be surveyed by downhole camera to verify casing integrity.

Borehole geophysical testing will be performed on the pilot corehole MW-8R to enhance the understanding of bedrock hydrogeology. The following downhole methods will be utilized:

- Downhole velocity survey;
- Caliper log; and,
- Temperature log.

The downhole geophysical data will be correlated with rock core logging and hydrogeologic test data. The short open borehole interval (10 feet) in the other three bedrock wells does not warrant additional geophysical investigation.

The geophysical logging procedures are described in Appendix B, Section 3.1 and Attachment B3.

#### **5.4.6 Sampling, Analysis, and Validation**

One round of groundwater samples will be collected from each new well in conjunction with the current quarterly monitoring program for existing wells. A minimum of 2 weeks

will be allowed prior to sampling the wells after development. Samples will be collected in accordance with the protocol outlined in the SAMP (Appendix B, Section 4.2). Samples will be analyzed for TCL and TAL constituents. Groundwater samples for metals will not be filtered (e.g. total metals). The objective of the groundwater sampling is to collect representative samples from the till/weathered bedrock and bedrock aquifers to evaluate off-property groundwater quality. Laboratory analytical results from new wells will be validated according to USEPA Region II Standard Operating Procedures.

As requested by the USEPA, downhole velocity logging will be performed at existing wells MW-5D, MW-7D, and MW-11D. These wells have relatively long screens which span different lithologies potentially having different flow characteristics. The result of the downhole velocity logging will be used to select one additional sampling level for each well (in addition to the midpoint of the screen) that will be sampled using low flow purging methodology. These additional samples, which will be taken on a single trial basis, will be analyzed for PCE and TCE only, as "fingerprint compounds" to assess potential inhomogeneity in contaminant transport at the scale of the screened interval.

#### **5.4.7 Meetings/Reporting**

A kick-off meeting is proposed with the Agencies prior to commencing field work. The purpose of this meeting is for Agency representatives to meet with the Investigation Leader to review the field program and discuss the detailed schedule for field activities. Additional meetings or conference calls will be held as necessary throughout the Investigation.

As soon as practical following completion of the off-property investigations, an Interim Data Report will be submitted to the Agencies. This report will emphasize graphical presentation of the data and will include the following as appropriate:

- Construction details of the wells;
- Geologic cross-sections
- Groundwater contour map(s);

- Synoptic water levels from the long-term monitoring;
- Validated analytical laboratory data; and
- Chemistry data plotted on plan maps.

A meeting will be scheduled with the Agencies to discuss the Interim Data Report and determine if additional investigations are necessary. A Draft Off-Property Investigation Report will be submitted to the Agencies following the meeting and will include the results of any additional investigations required.

The Draft Report will include the following as applicable:

- A summary of field procedures;
- Geologic and hydrogeologic interpretations;
- A table of monitoring well data;
- As-built construction diagrams of the monitoring wells;
- Borehole soil and rock logs;
- Validated analytical laboratory data;
- Geologic and hydrogeologic cross-sections;
- Groundwater contour map(s) and tabulated synoptic-water level measurements from the long-term monitoring; and,
- Contaminant isopleth(s).

It is anticipated that the substantive features of the report will have been discussed with the Agencies through meetings or conference calls prior to submittal which will facilitate and expedite the review and comment period. A Final Off-Property Investigation Report will incorporate modifications based on Agency comments.

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## 5.5 Access

All of the proposed new wells are located off-property and will require access agreements with the current landowners prior to installation. The existing tax maps maintained by the Borough of Carlstadt indicate that the proposed wells are located on properties owned by Wilson Associates, New Jersey Sports and Exposition Authority and ABF Freight Systems (successors to Carolina Freight Corporation). Access agreements currently exist with each of these landowners for the quarterly sampling events. However, the access agreements may have to be revised to include installation and sampling of additional monitoring wells. Discussions with each of the affected landowners have been initiated to secure modified access agreements for additional work; however, fieldwork cannot commence until access has been formally provided by each of the landowners. Proposed locations of monitoring wells may be modified slightly, if necessary, to facilitate landowner approval of access; any material modifications required by the landowners will be referred to USEPA for concurrence before proceeding.

As requested by USEPA, discussions regarding access agreements will be initiated with the landowner of other surrounding properties as a contingency basis for additional field work.

## 5.6 Off-Property Investigation Organization

Figure 6 presents the Organization Chart for the Investigation. The USEPA Case Manager, Richard Puvogel, will coordinate with the NJDEP Case Manager, Riché Outlaw, and serve as the primary contact with the Facility Coordinator, Steve Finn of Golder Associates. The Facility Coordinator will provide overall management of activities related to the Investigation and coordination between the Agencies and the Group. Mr. Finn will be assisted by Robert Illes within Golder Associates.

The Off-Property Investigation Manager at Golder Associates (Stuart Mitchell, P.G.) will be responsible for the technical aspects of the Investigation and coordinating the various subcontractors. Subcontractors will include New Jersey Licensed drilling and surveying firms together with a CLP and New Jersey certified analytical laboratory. Mr. Mitchell has 9 years

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experience managing environmental investigations in New Jersey with Golder Associates and previously with the NJDEP; his resume is included in Appendix A.

## **5.7 Schedule**

The proposed schedule for the Investigation is presented on Figure 7b.

The start of field work is contingent on securing access agreements. A 3 1/2-month period is allotted for conducting the fieldwork and chemistry analysis followed by a 2 1/2-month period to submit the Interim Data Report. A 2-month comment/response period is envisioned following submittal of the Interim Data Report which includes 1 month Agency review period and 1 month response period. A 5 month contingency is included for additional investigatory work following the Interim Data Report submittal.

A 2 1/2-month period is allotted for submitting the Draft Off-Property Investigation Report upon completion of all field work.. A 3-month comment/response period is envisioned following submittal of the Draft Off-Property Investigation Report which includes a 1-month Agency review period and a 2-month for response and submittal of the Final Off-Property Investigation Report.

It should be noted that a 30 day response period to finalize the Remedial Investigation Report is indicated in the RI/FS Order following receipt of Agency comments. In compliance with this requirement, a meeting or conference call will be held with the Agencies within 30 days of receipt of comments to agree on modifications to the Off-Property Investigation Report based on Agency comments. Following the meeting or conference call, it is envisioned that red-line revisions to sections of the report will be provided to the Agencies. The Final Off-Property Investigation Report will be submitted once the modifications have been approved by USEPA. This approach is expected to provide the most efficient and timely completion of the Investigation.



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**6.0 FFS AND OFF-PROPERTY INVESTIGATION INTERACTION**

This Work Plan presents a schedule in which the FFS for FOU soils is being conducted concurrently with the Off-Property Investigation. The Group believes that these issues must be addressed concurrently to provide the necessary information for the selection of a comprehensive and cost effective Site-wide remedy. Implementation of the Interim Remedy has established source control measures for the FOU. Selection of a final remedy for the FOU should be made giving necessary consideration to the range of potential solutions for the Off-Property issues and vice versa.

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**Table 1A**  
**First Operable Unit Soil Chemistry Summary**  
**216 Paterson-Plank Road Site**  
**Shallow Soil (0-2')**

Compound	Initial EPA PRG (ppm)	Frequency of Detections	Number of Detections Above PRG	Maximum Concentration (ppm)
<b>Volatiles</b>				
1,1,1-Trichloroethane	184000	1/17	0	2.49
1,1,2,2-Tetrachloroethane	28	1/17	0	0.288
1,1,2-Trichloroethane	100	2/17	0	1.810
1,1-Dichloroethane	200000	2/17	0	64.7
1,1-Dichloroethene	9.6	2/17	0	0.182
1,2-Dichlorobenzene	184000	8/17	0	47.3
1,2-Dichloroethane	62	4/17	0	10.2
1,3-Dichlorobenzene	184000	0/17	0	0.962
2-Butanone (Methyl-ethyl-ketone)	1220000	2/17	0	8.56
Benzene	198	4/17	0	53.9
Chlorobenzene	40000	4/17	0	336
Chloroethane	40000	0/17	0	BMDL
Chloroform	940	4/17	0	17.8
Ethylbenzene	200000	7/17	0	652
Methylene Chloride	760	11/17	0	2.39
Styrene	400000	0/17	0	BMDL
Tetrachloroethene	110	12/17	3	4290
Toluene	400000	8/17	0	3380
Total Xylenes	4000000			
(m) Xylenes		7/17	0	2000
(o+p) Xylenes		9/17	0	1450
trans-1,2-Dichloroethene	40000	5/17	0	0.241
Trichloroethene	520	12/17	1	2060
Vinyl Chloride	3	0/17	0	BMDL
<b>Semivolatiles</b>				
1,2,4-Trichlorobenzene	20000	2/17	0	1.69
2,4-Dichlorophenol	6200	1/17	0	1.102
2,4-Dimethylphenol	40000	2/17	0	1.12
2-Chloronaphthalene		2/17	NA	0.22
2-Chlorophenol	10200	0/17	0	BMDL
2-Nitrophenol		0/17	NA	BMDL
Acenaphthene	122000	9/17	0	2.7
Acenaphthylene	61000	1/17	0	0.56
Anthracene	620000	9/17	0	3.9
Benzidine	0.024	0/17	0	BMDL
Benzo(a)Anthracene	7.8	5/17	0	4.54
Benzo(a)Pyrene	0.78	9/17	9	9.39
Benzo(b)Fluoranthene	7.8	6/17	2	17.7
Benzo(g,h,i)Perylene		7/17	NA	6.95
Benzo(k)Fluoranthene	78	1/17	0	3.79
bis(2-Chloroethyl)ether	5.2	0/17	0	BMDL
bis(2-Ethylhexyl)Phthalate	400	17/17	0	281
Butylbenzylphthalates	400000	8/17	0	86.1
Chrysene	78000	11/17	0	5.5
Di-n-butylphthalate		13/17	NA	71
Di-n-Octyl Phthalate	40000	6/17	0	9.05
Dibenz(a,h)Anthracene	0.78	2/17	1	2.4
Diethylphthalate	1640000	1/17	0	5.09
Dimethyl Phthalate	2000000	0/17	0	BMDL
Fluoranthene	82000	16/17	0	15.3
Fluorene	82000	9/17	0	11.0
Indeno(1,2,3-cd)Pyrene	7.8	7/17	1	12.1
Isophorone	6000	0/17	0	BMDL
N-Nitrosodiphenylamine	1160	3/17	0	2.98
Naphthalene	82000	16/17	0	102
Nitrobenzene	1020	1/17	0	117
Phenanthrene		13/17	NA	23.6
Phenol	50000	4/17	0	58.2
Pyrene	62000	15/17	0	12.7

**Table 1A**  
**First Operable Unit Soil Chemistry Summary**  
**216 Paterson-Plank Road Site**  
**Shallow Soil (0-2')**

Compound	Initial EPA PRG (ppm)	Frequency of Detections	Number of Detections Above PRG	Maximum Concentration (ppm)
<b>Pesticides</b>				
4,4'-DDE	16.8	0/17	0	BMDL
4,4'-DDT	16.8	0/17	0	BMDL
Aldrin	0.34	3/17	1	57
beta-BHC	3.6	0/17	0	BMDL
Dieldrin	0.36	5/17	5	57
Endosulfan I	102	0/17	0	BMDL
Endosulfan II	102	0/17	0	BMDL
Endrin	620	0/17	0	BMDL
Methoxychlor	10200	0/17	0	BMDL
<b>PCB's</b>				
Aroclor-1242	10-25	11/17	5-4	15000
Aroclor-1248	10-25	4/17	3-1	23
Aroclor-1254	10-25	4/17	1-0	12
Aroclor-1260	10-25	2/17	1-1	48
<b>Total Metals</b>				
Antimony	820	3/17	0	16
Arsenic	3.2	14/17	13	60
Beryllium	1.34	17/17	1	57.6
Cadmium	1020	17/17	0	95.1
Chromium	10200 (VI)	17/17	0	870
Copper	76000	17/17	0	71600
Cyanide	40000	16/17	0	34
Lead	500 - 1000	17/17	8-2	2750
Mercury	620	17/17	0	21.3
Nickel	40000	15/17	0	39
Selenium	10200	5/17	0	4.9
Silver	10200	7/17	0	6.4
Thallium	144	0/17	0	BMDL
Zinc	620000	17/17	0	4170
<b>Wet Chemistry</b>				
Phenolics (Total)	50000	16/17	0	600
Petroleum Hydrocarbons		17/17	NA	81600

**Notes:**

1. Initial EPA PRGS taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.
2. Soil chemistry data taken from the Remedial Investigation Final Report, dated March 1990, by Dames and Moore.
3. BMDL - Below Method Detection Limit.

**Table 1B**  
**First Operable Unit Soil Chemistry Summary**  
**216 Paterson-Plank Road Site**  
**Saturated Fill (5-6')**

Compound	Initial EPA PRG (ppm)	Frequency of Detections	Number of Detections Above PRG	Maximum Concentration (ppm)
<b>Volatiles</b>				
1,1,1-Trichloroethane	184000	3/17	0	1770
1,1,2,2-Tetrachloroethane	28	1/17	0	0.703
1,1,2-Trichloroethane	100	1/17	0	15.7
1,1-Dichloroethane	200000	3/17	0	179
1,1-Dichloroethene	9.6	0/17	0	BMDL
1,2-Dichlorobenzene	184000	6/17	0	385
1,2-Dichloroethane	62	4/17	2	290
1,3-Dichlorobenzene	184000	0/17	0	BMDL
2-Butanone (Methyl-ethyl-ketone)	1220000	5/17	0	795
Benzene	198	7/17	0	52.3
Chlorobenzene	40000	6/17	0	258
Chloroethane	40000	0/17	0	BMDL
Chloroform	940	3/17	0	379
Ethylbenzene	200000	15/17	0	529
Methylene Chloride	760	8/17	0	14.9
Styrene	400000	0/17	0	BMDL
Tetrachloroethene	110	12/17	5	1690
Toluene	400000	16/17	0	2410
Total Xylenes	4000000			
(m) Xylenes		16/17	0	1580
(o+p) Xylenes		16/17	0	710
trans-1,2-Dichloroethene	40000	5/17	0	512
Trichloroethene	520	8/17	2	1670
Vinyl Chloride	3	1/17	0	0.0289
<b>Semivolatiles</b>				
1,2,4-Trichlorobenzene	20000	1/17	0	0.350
2,4-Dichlorophenol	6200	0/17	0	BMDL
2,4-Dimethylphenol	40000	3/17	0	10.8
2-Chloronaphthalene		3/17	NA	18.2
2-Chlorophenol	10200	0/17	0	BMDL
2-Nitrophenol		0/17	NA	BMDL
Acenaphthene	122000	8/17	0	21.2
Acenaphthylene	61000	1/17	0	21
Anthracene	620000	7/17	0	86.3
Benzidine	0.024	1/17	1	244
Benzo(a)Anthracene	7.8	5/17	1	84.2
Benzo(a)Pyrene	0.78	7/17	4	108
Benzo(b)Fluoranthene	7.8	6/17	2	164
Benzo(g,h,i)Perylene		5/17	NA	73.3
Benzo(k)Fluoranthene	78	0/17	0	BMDL
bis(2-Chloroethyl)ether	5.2	0/17	0	BMDL
bis(2-Ethylhexyl)Phthalate	400	14/17	0	381
Butylbenzylphthalates	400000	6/17	0	73.6
Chrysene	78000	7/17	0	106
DI-n-butylphthalate		6/17	NA	98.2
DI-n-Octyl Phthalate	40000	5/17	0	19.5
Di benz(a,h)Anthracene	0.78	0/17	0	BMDL
Diethylphthalate	1640000	0/17	0	28.5
Dimethyl Phthalate	2000000	0/17	0	BMDL
Fluoranthene	82000	13/17	0	176
Fluorene	82000	9/17	0	94.1
Indeno(1,2,3-cd)Pyrene	7.8	4/17	1	86.9
Isophorone	6000	0/17	0	BMDL
N-Nitrosodiphenylamine	1160	1/17	0	0.157
Naphthalene	82000	14/17	0	480
Nitrobenzene	1020	1/17	1	1350
Phenanthrene		9/17	NA	268
Phenol	50000	4/17	0	790
Pyrene	62000	12/17	0	118

**Table 1B**  
**First Operable Unit Soil Chemistry Summary**  
**216 Paterson-Plank Road Site**  
**Saturated Fill (5-6')**

Compound	Initial EPA PRG (ppm)	Frequency of Detections	Number of Detections Above PRG	Maximum Concentration (ppm)
<b>Pesticides</b>				
4,4'-DDE	16.8	0/17	0	BMDL
4,4'-DDT	16.8	0/17	0	BMDL
Aldrin	0.34	1/17	1	1.2
beta-BHC	3.6	0/17	0	BMDL
Dieldrin	0.36	3/17	2	0.940
Endosulfan I	102	0/17	0	BMDL
Endosulfan II	102	0/17	0	BMDL
Endrin	620	0/17	0	BMDL
Methoxychlor	10200	1/17	0	150
<b>PCB's</b>				
Aroclor-1242	10-25	12/17	4-3	350
Aroclor-1248	10-25	2/17	0	9.7
Aroclor-1254	10-25	3/15	0	3.5
Aroclor-1260	10-25	2/17	0	10
<b>Total Metals</b>				
Antimony	820	4/17	0	38
Arsenic	3.2	15/17	12	62
Beryllium	1.34	17/17	0	1.3
Cadmium	1020	16/17	0	26
Chromium	10200 (VI)	17/17	0	542
Copper	76000	17/17	0	8600
Cyanide	40000	9/17	0	32
Lead	500 - 1000	17/17	8-5	2810
Mercury	620	16/17	0	13.6
Nickel	40000	17/17	0	116
Selenium	10200	3/17	0	2.1
Silver	10200	1/17	0	40
Thallium	144	0/17	0	BMDL
Zinc	620000	17/17	0	1870
<b>Wet Chemistry</b>				
Phenolics (Total)	50000	15/17	0	683
Petroleum Hydrocarbons		17/17	0	29600

**Notes:**

1. Initial EPA PRGS taken from a letter dated November 19, 1993 from EPA to Langan Environmental Services.
2. Soil chemistry data taken from the Remedial Investigation Final Report, dated March 1990, by Dames and Moore.
3. BMDL - Below Method Detection Limit.
4. Analyses of saturated soil samples taken from below the water table will be biased high by virtue of groundwater contamination.



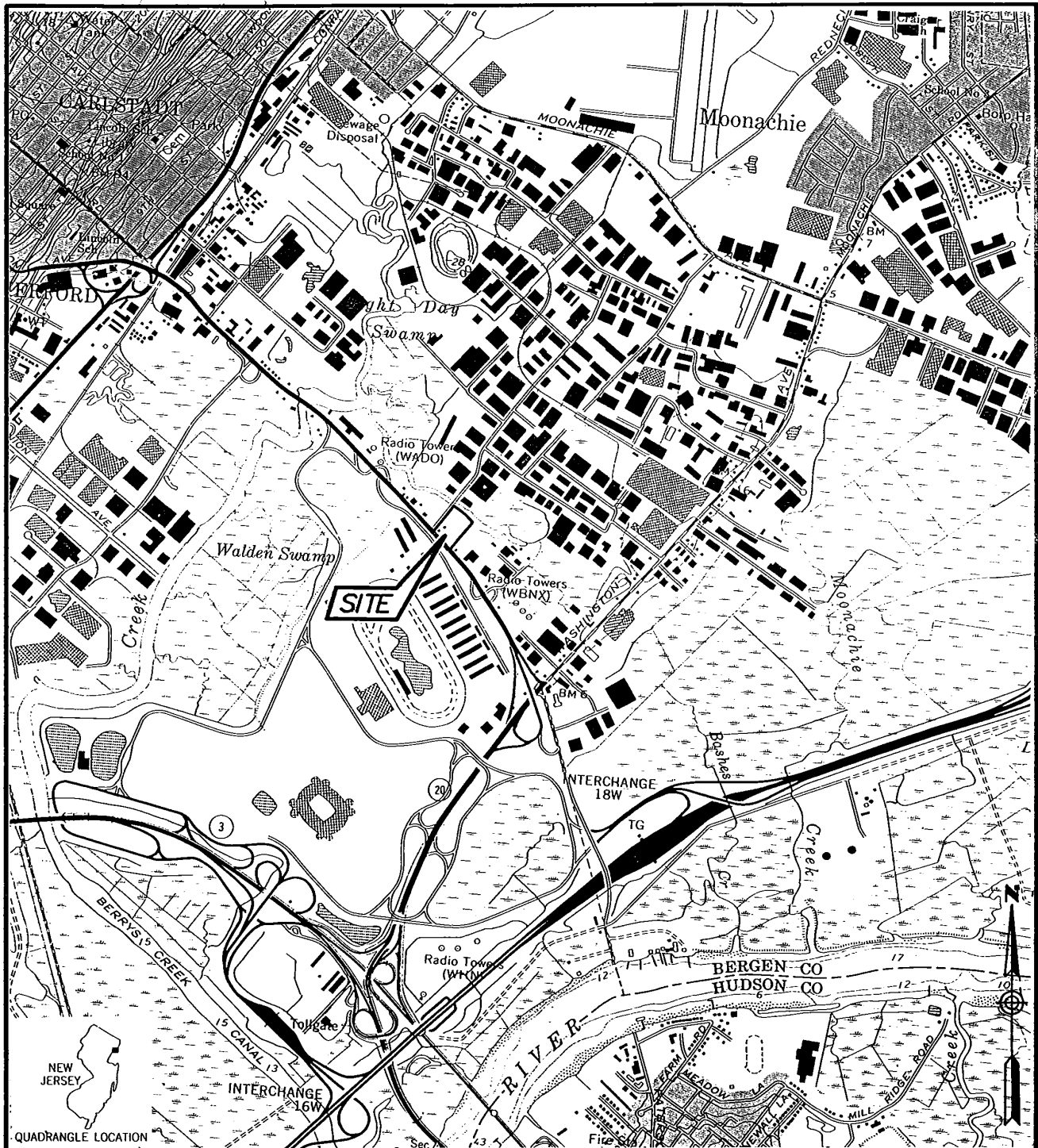
**TABLE 2**  
**Summary of Total VOC Concentrations**  
**216 Paterson Plank Road Site**

Monitoring Well I.D.	Total VOC Concentrations (ug/l)													
	Sampling Events													
	July '87	Dec. '87	Feb. '89		June '92	Oct. '92	Jan. '93	April '93	Aug. '93	Nov. '93	April '94	Jan. '95	April '95	July '95
MW-2D	44,742	73,340			32,560	4,131	3,849	1,848	1,359	1,199	1,200	4,063	803	832
MW-5D	6,813	5,757			6,243	321	5,584	3,197	5,674	5,420	3,219	4,352	3,020	3,245
MW-7D	163	26			ND	1	ND	4	10	ND	35	3	7	7
MW-8D			18		2,731	1,944	2,871	2,382	2,246	2,182	1,156	1,262	1,789	2,254
MW-11D			920		23,080	2,271	24,530	19,090	10,569	10,480	19,108	18,530	33,560	34,090
MW-12D			12,618		6,907	12,740	11,445	5,632	4,619	8,719	5,000	8,097	5,608	5,469
MW-13D			3,229		450	648	3,841	2,324	2,259	3,665	2,652	644	1,014	798
MW-2R			1,312		7,958	1,550	3,710	3,760	2,291	2,039	1,296	683	616	958
MW-8S			69		ND	4	14	123	5	2	ND	ND	ND	7
MW-9S			ND		ND	2	ND	42	ND	ND	ND	ND	ND	14
MW-10S			ND		ND	ND	ND	ND	1	ND	ND	ND	ND	4
MW-11S			ND		ND	ND	8	8	ND	ND	ND	ND	ND	4
MW-12S			5		ND	14	ND	ND	ND	ND	ND	ND	ND	5

## Notes:

ND = Non-Detect

Total VOCs calculated from primary samples.



# REFERENCE

- 1.) USGS 7.5 MINUTE WEEHAWKEN QUADRANGLE, NEW JERSEY - NEW YORK, DATE 1967, PHOTOREVISED 1981.

DEC 21 1995

2000 0 2000

scale feet

JOB No.:	943-6222	SCALE:	AS SHOWN
DR BY:	JSG	DATE:	06/05/95
CHK BY:	SOM	FILE No.:	NJ03-266
REV BY:	RL	DR SUBTITLE:	03

## SITE LOCATION PLAN





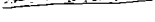

**Golder Associates**

216 PATERSON PLANK ROAD SITE

FIGURE 1

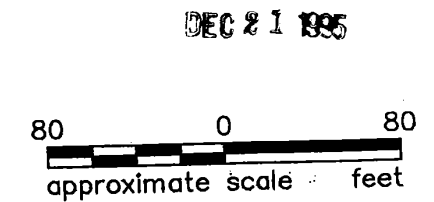
R2-0000054

# LEGEND

-  MW-6SR GROUNDWATER EXTRACTION WELLS
-  MW-13D EXISTING GROUNDWATER MONITORING WELL
-  P-3 EXISTING PIEZOMETER
-  -8- EXISTING GROUND CONTOURS
-  EXISTING SLURRY WALL
-  EXISTING SHEET PILE WALL

## NOTES

- 1.) BASE MAP TAKEN FROM LANGAN ENGINEERING AND ENVIRONMENTAL SERVICES, INC. QUARTERLY O&M MONITORING REPORT, DATED AUGUST 5, 1994.
- 2.) RMW-13D WAS INSTALLED IN OCTOBER 1995. THE LOCATION SHOWN IS APPROXIMATE.

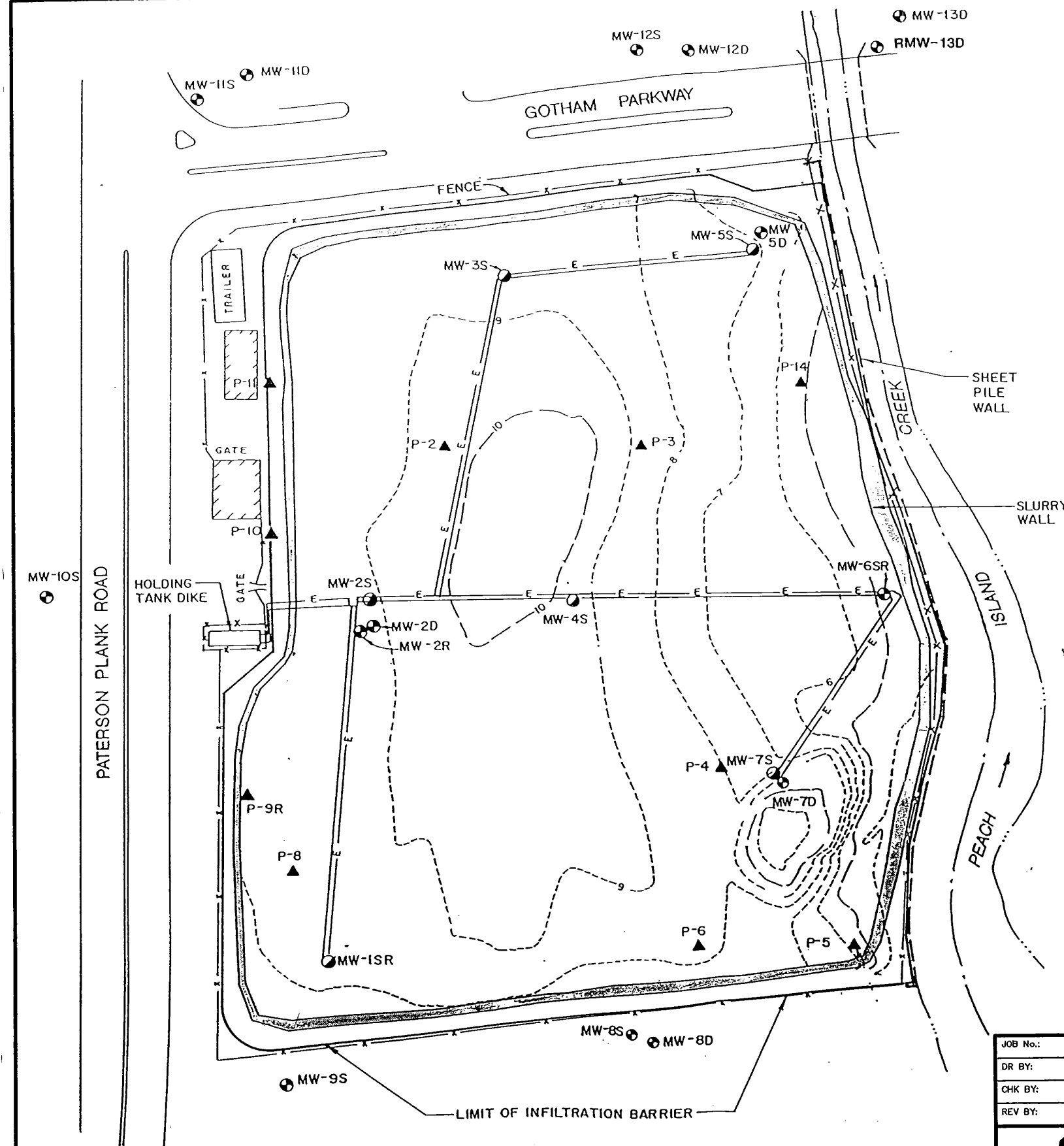


JOB No.:	943-6222	SCALE:	AS SHOWN
DR BY:	JSG	DATE:	12/19/95
CHK BY:	SDM	FILE No.:	1NJ03-264
REV BY:		DR SUBTITLE:	03

**Golder Associates**

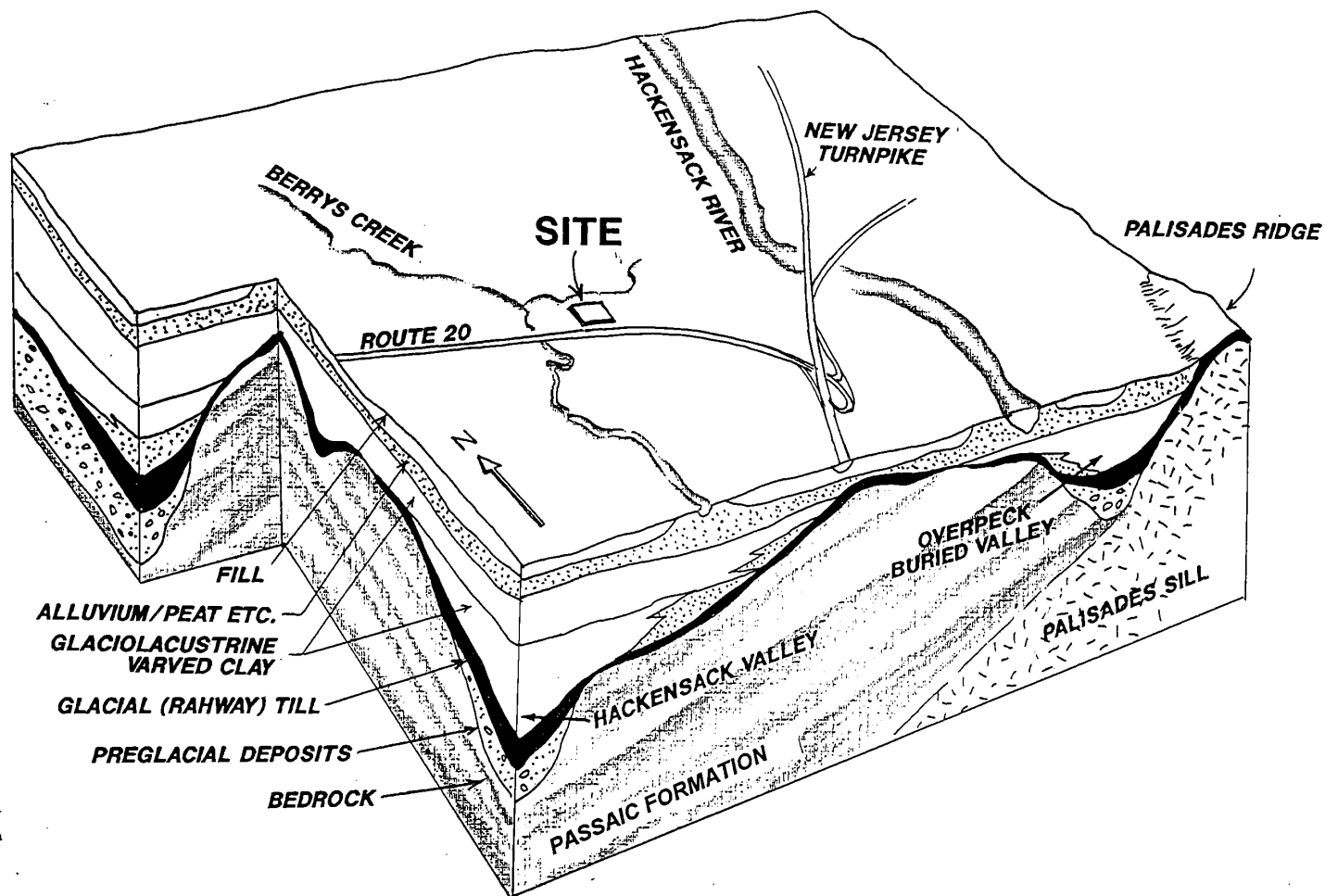
216 PATERSON PLANK ROAD SITE

FIGURE  
**2**



JOB No.:	943-6222	SCALE:	AS SHOWN
DR BY:	JSG	DATE:	12/19/95
CHK BY:	SDM	FILE No.:	NJ03-268
REV BY:	BSL	DR SUBMIT:	03
Golder Associates			
REGIONAL GEOLOGY			
216 PATERSON PLANK ROAD SITE			FIGURE 3

DEC 21 1995





**INFILTRATION BARRIER**

**FILL**; variable thickness; including asphalt, timber, concrete, brick etc. STP blow counts are highly variable.

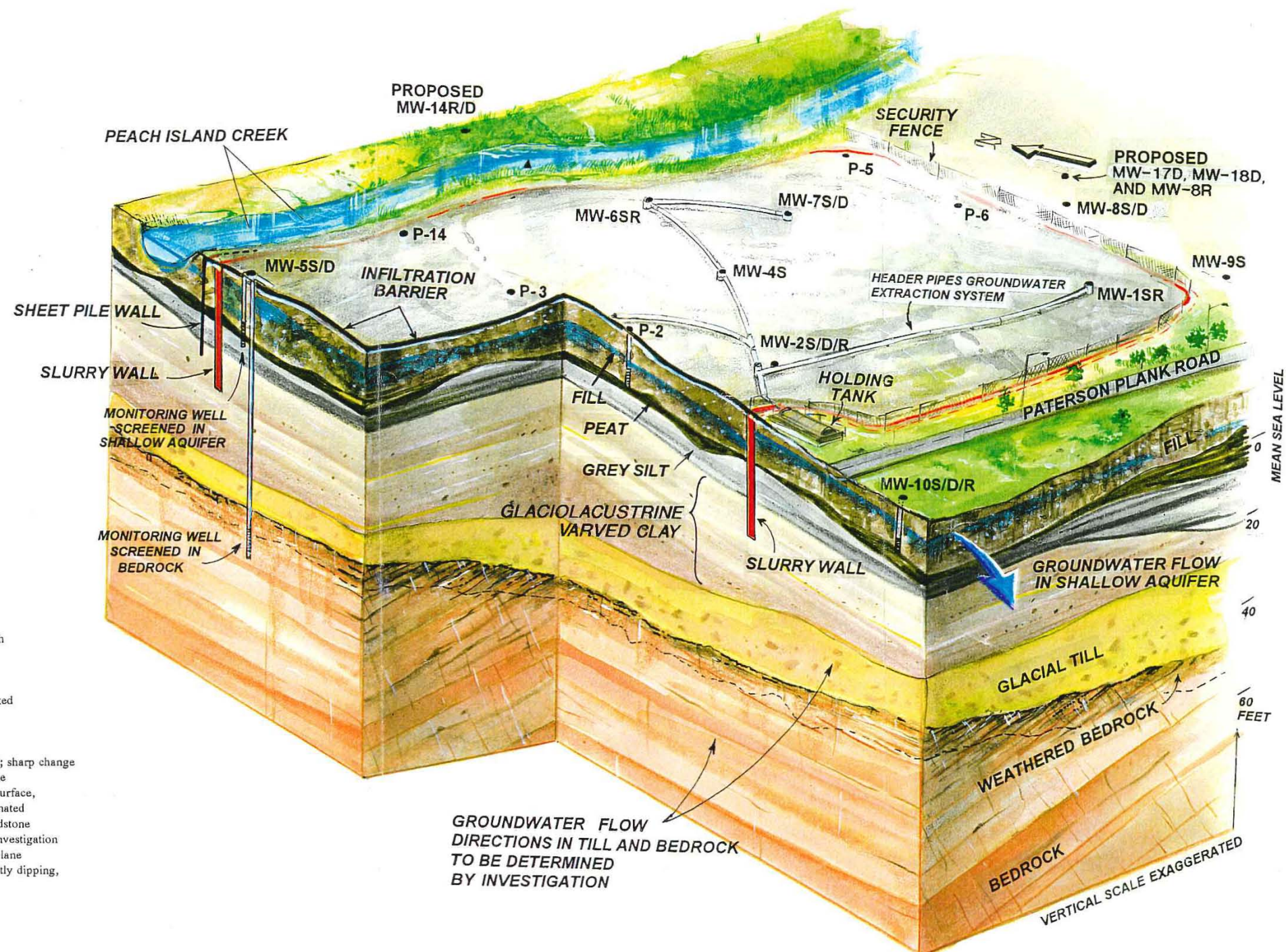
**PEAT**; dark color, organic, silty, with fine sand stringers, occasional debris laterally discontinuous, variable thickness

**GREY SILT**; uniform thickness, mottled clayey silt, finely bedded/laminated, basal gravel or sandy bed in places (hydrogeologically, above units comprise shallow, surficial aquifer units)

**GLACIOLACUSTRINE VARVED CLAY** - glaciolacustrine clayey silt, silty clay; upper portion is generally varved with seasonal dark and light layers of silts/fine sands and clays lower unit is massive, to sometimes rhythmically bedded characteristically red colored clay; basal portions may include red sand, silt, or gravelly beds; top of the unit presents a sharp lithologic break with grey silt unit. Unit is uniformly plastic to lean when clay content is high. Blow counts are generally less than N=10 (aquitard bed separating shallow aquifer from deeper aquifer below).

**GLACIAL TILL**; silty, sandy, clayey, unit with rounded to sub-rounded gravel, generally red to brown in color; few interspersed gravel and or sand interbeds may locally present higher N counts up to N=40. Bottom of the unit marked strongly along a zone where blow counts reach N=100 or more.

**WEATHERED BEDROCK AND BEDROCK**; sharp change in STP blow counts and marked increase in shale fragments marks top of the weathered bedrock surface. Bedrock underlying the site is bedded, and laminated consisting of shales, siltstone and occasional sandstone bed. Intact bedrock, upto the depth of known investigation at site is fractured by joint planes and bedding plane partings. Dip of bedrock is subhorizontal to gently dipping, possibly to the northwest.  
(glacial till and bedrock units consist of the lower or deeper confined aquifer)



DEC 21 1995

JOB No.:	943-6222	SCALE:	AS SHOWN
DR BY:	RV	DATE:	10/25/95
CHK BY:	SDM	FILE No.:	NJ03-312
REV BY:		DR SUBTITLE:	06

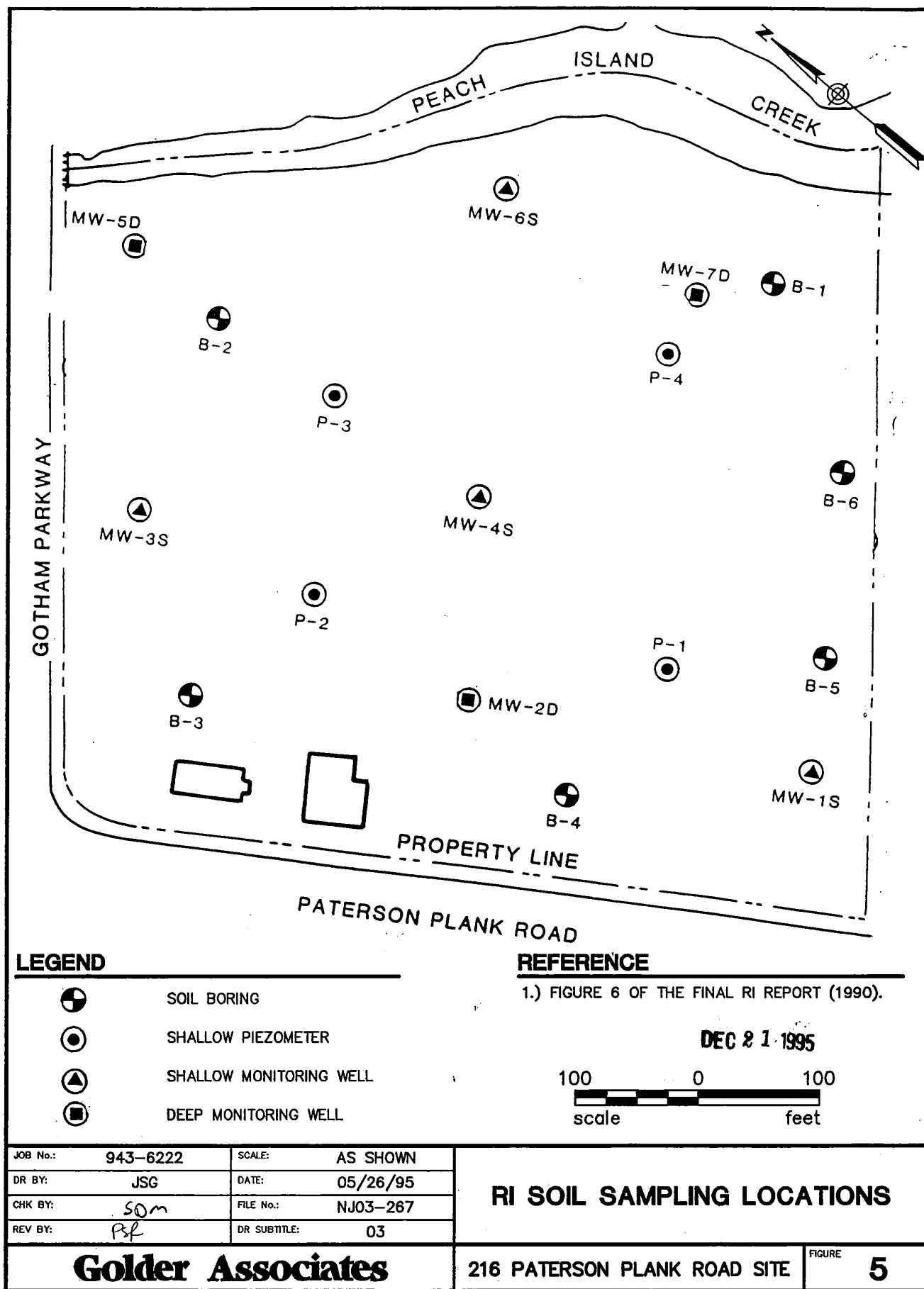
## CONCEPTUAL BLOCK DIAGRAM

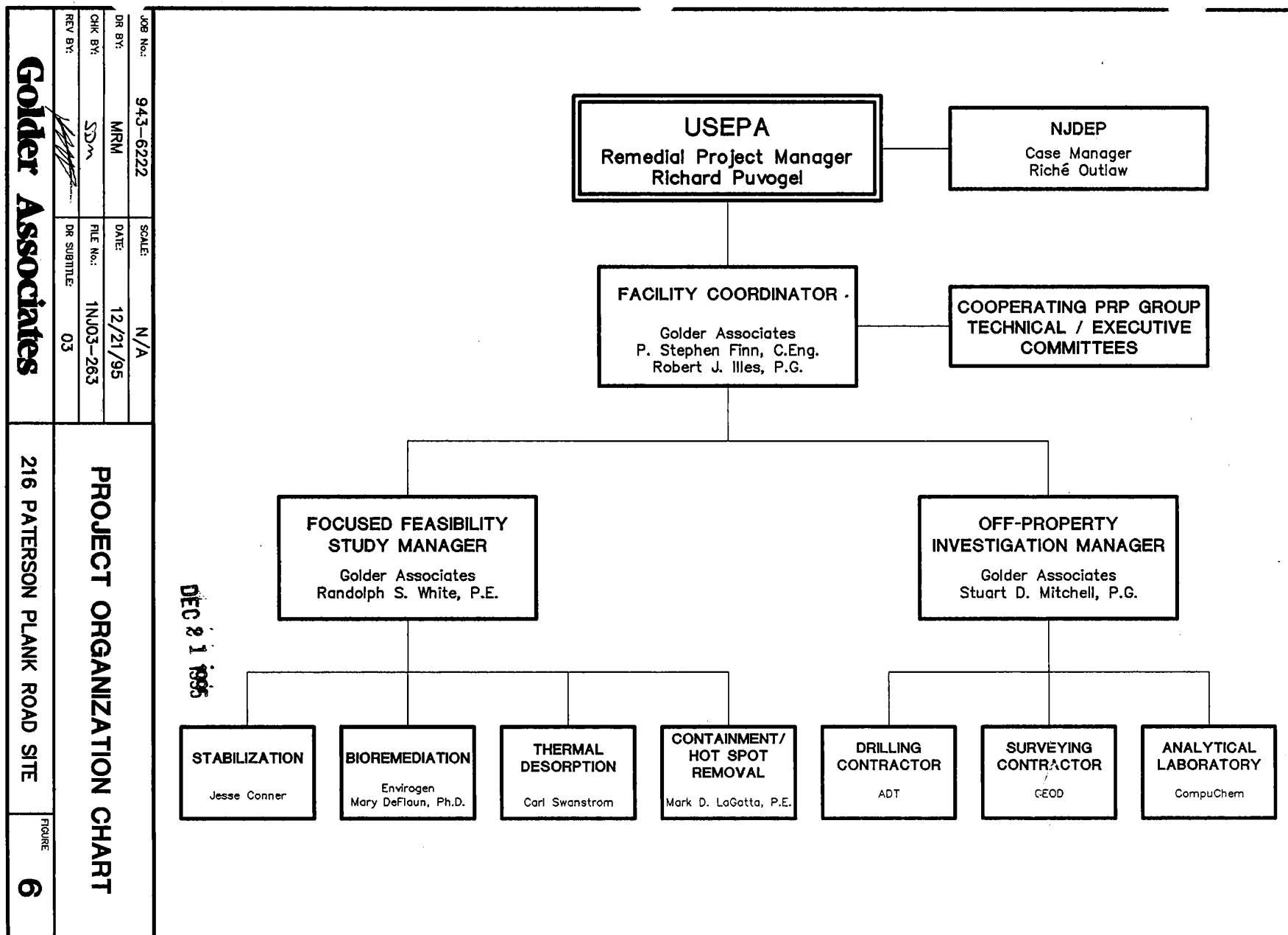
**Golder Associates**

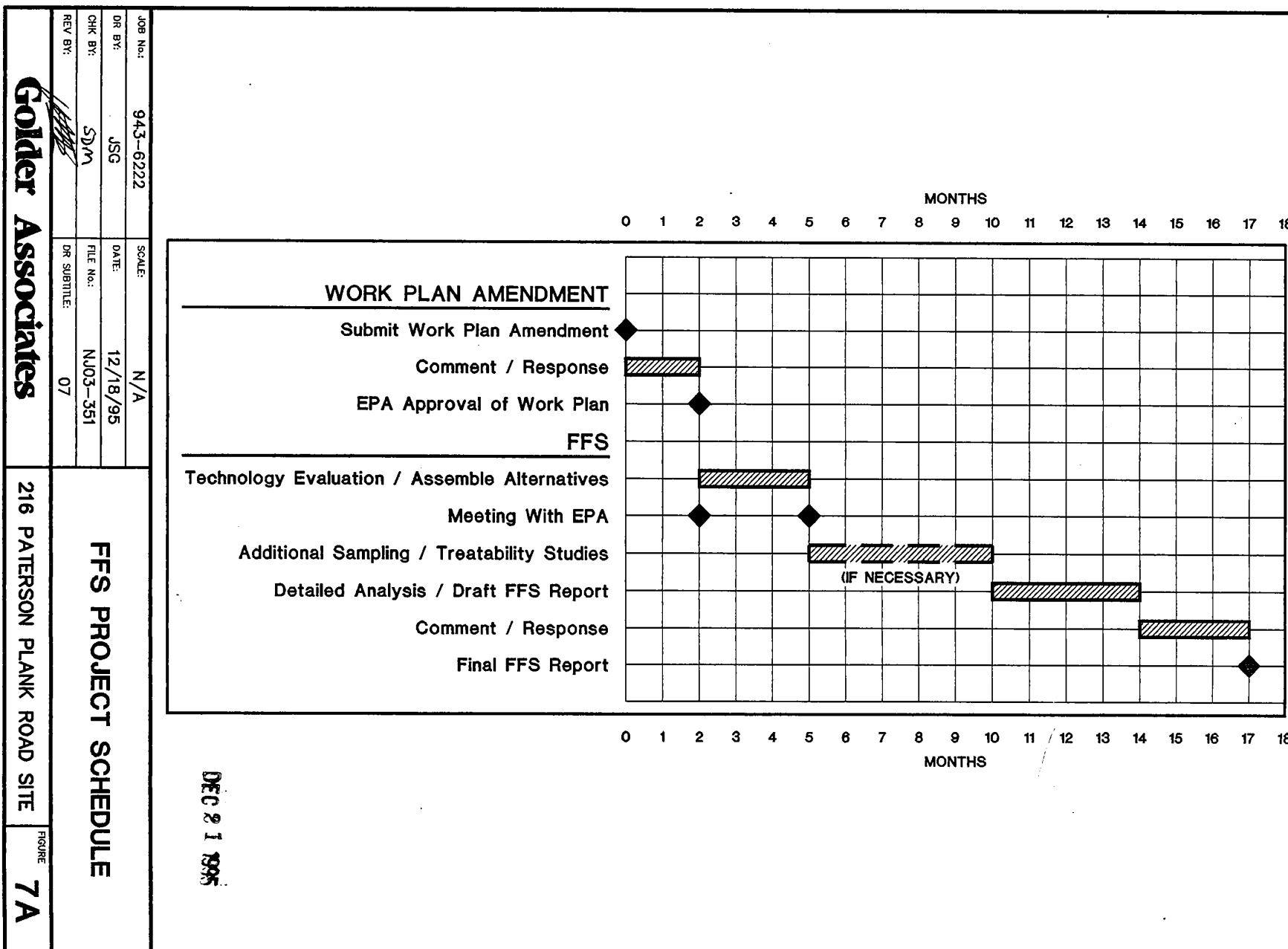
216 PATERSON PLANK ROAD SITE

FIGURE  
**4**

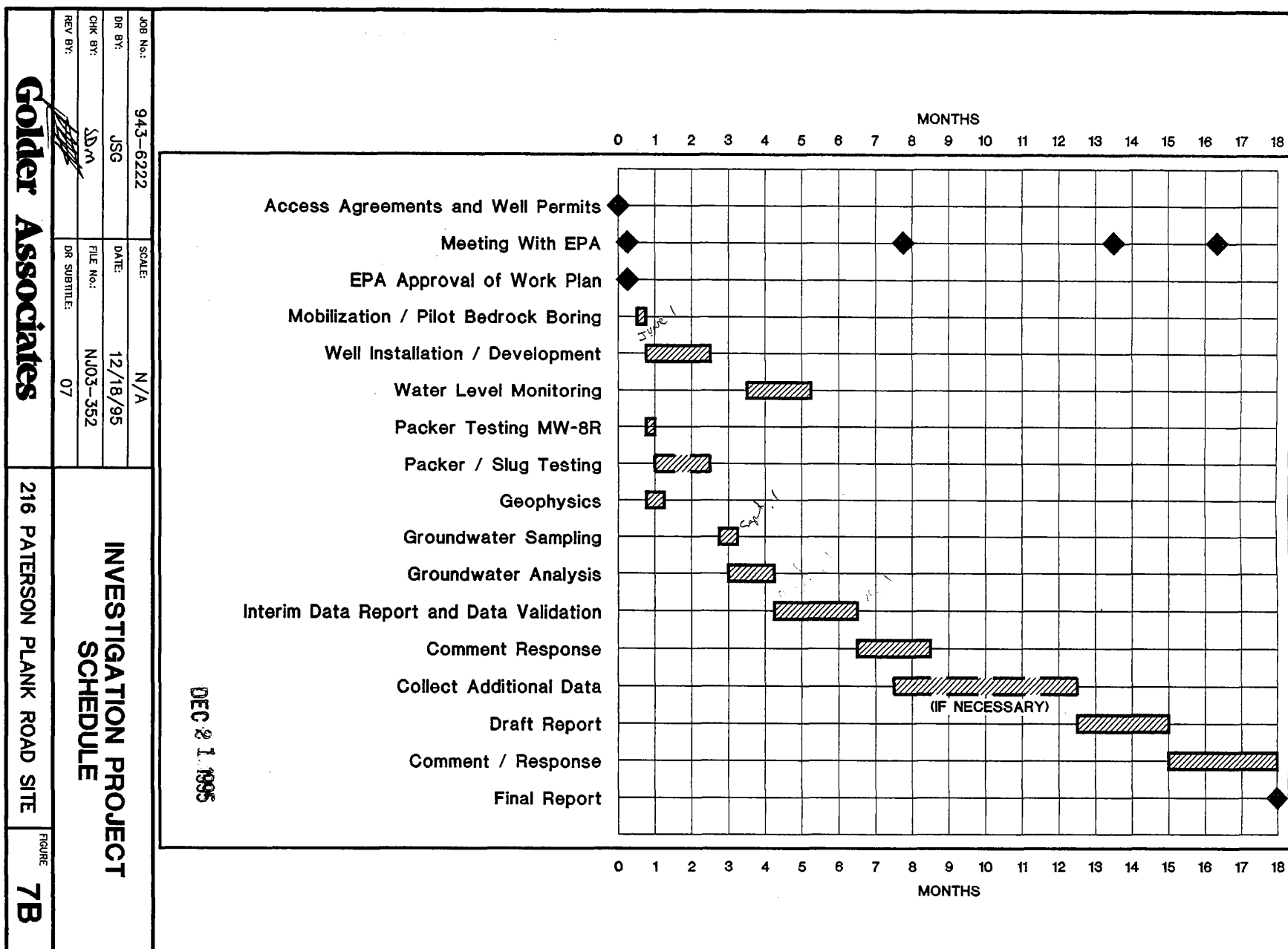




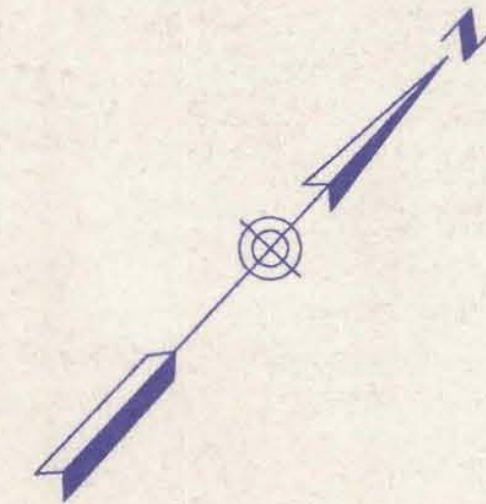
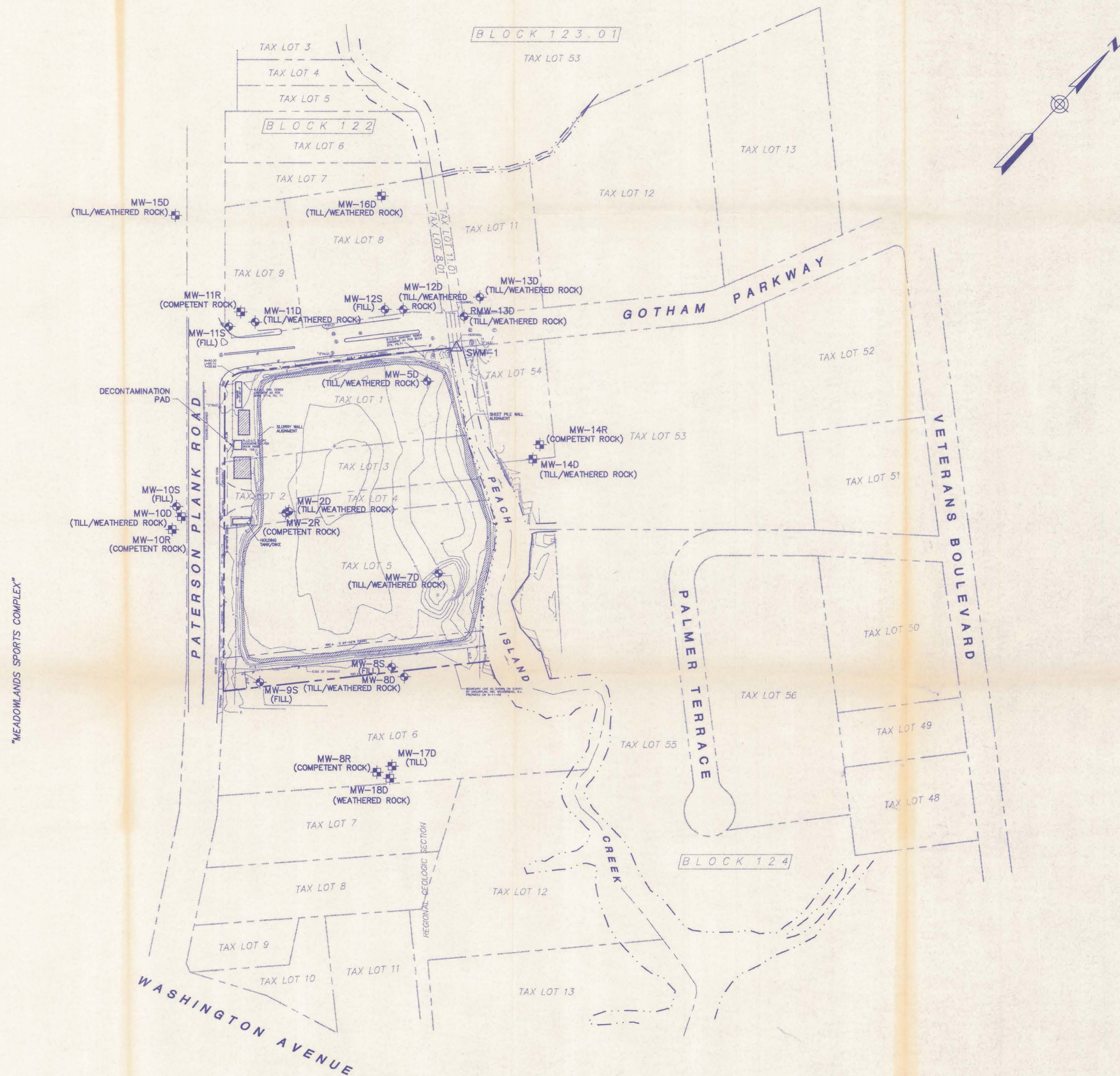












VETERANS BOULEVARD

PALMER TERRACE

CREEK

WASHINGTON AVENUE



## **APPENDIX A**

### **Resumes**

## P. Stephen Finn, C. Eng.



**Education** B.Sc., (1st class honors) Civil Engineering, University of Bristol, U.K., 1977  
M.S., Geotechnical Engineering, University of California, Berkeley, 1982  
Postgraduate course in Engineering Seismology, Imperial College, University of London, U.K., 1983

**Affiliations** Chartered Engineer, U.K.  
Member, Institution of Civil Engineers, U.K.

### Experience

1990 to date **Golder Associates Inc.** **Mt. Laurel, NJ**  
*Principal and Group Director, formerly Associate.*  
Responsible for management and technical direction of CERCLA projects undertaken by the Mt. Laurel, NJ, and Manchester, NH, offices. Experience includes 15 CERCLA sites involving RI/FS, Remedial Design, Remedial Action Oversight and review of completed remedial measures. Sites include active and former chemical manufacturing plants, landfills, and waste handling facilities throughout USEPA Regions I, II, III, V, and VII. Mr. Finn has extensive experience of negotiating cost-effective remedial approaches to groundwater and soil contamination problems at these sites including the use of innovative remediation technologies. Previously Project Manager for various solid waste landfill designs including novel use of deep dynamic compaction to enhance air space on an active landfill.

1986 - 1990 **Soil Mechanics Ltd.** **U.K.**  
*Divisional Director.*  
General management responsibility for specialist consultancy division. Projects included major supervisory control and data acquisition systems for water treatment plants, dynamic laboratory testing, and foundation piling.

1983 - 1986 **Soil Mechanics Ltd.** **U.K.**  
*Research & Development Manager.*  
Management responsibility for R&D department with multi-discipline technical staff. Development of new in-situ geotechnical testing services based on pressuremeters, penetrometers, dilatometers, and permeability measurements.

1982 - 1983 **Soil Mechanics Ltd.** **U.K.**  
*Senior Engineer.*  
Investigation of geotechnical failures; geotechnical analysis for major U.K. road projects and the Baghdad Metro, Iraq.

1981 - 1982 Postgraduate student. University of California, Berkeley.

1979 - 1981 **Soil Mechanics Ltd.** **Hong Kong**  
*Project Engineer.*  
Responsible for land and marine geotechnical investigation and design projects in Hong Kong, Macao, and the Philippines. Design of soil and rock slopes, retaining structures, deep basements, piled and raft foundations, land reclamation, and groundwater control.

## **P. Stephen Finn, C. Eng.**

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1977 - 1979

**Soil Mechanics Ltd.**

**U.K.**

*Graduate Engineer.*

Site supervision of major ground investigations, geotechnical design, and technical report preparation for experimental nuclear plant and major road schemes.

### **Publications**

10 publications on landfill design and performance, foundation and slope design, instrumentation, in situ testing and data management.

## Robert J. Illes



### Education

M.Sc., Engineering Geology, Kent State University, Kent, Ohio, 1987  
B.Sc., Geology, Vanderbilt University, Nashville, Tennessee, 1985

### Experience

1992 to Date

#### **Golder Associates**

#### **Mt. Laurel, New Jersey**

*Senior Project Manager, formerly Senior Engineering Geologist.*

Responsible for the Project Management and technical direction of multi-discipline environmental and engineering projects. Specific projects include: the preparation and implementation of a Post-Remedial Environmental Monitoring Plan for the South Brunswick Landfill CERCLA site; the preparation of a Post-Closure Monitoring and Maintenance Plan and preparation of the Annual Post-Closure Monitoring Report at the Monroe Township Landfill CERCLA site; the Remedial Design at the Global Landfill CERCLA site including preparation and implementation of a Pre-Design Investigation Work Plan, preparation of the PDI Report, groundwater modeling using MODFLOW, and preparation of a Remedial Action Work Plan in accordance with New Jersey Site Remediation Regulations (7:26E); and, extraction well installation, geotechnical investigation and water balance analysis at the Fine Chemical facility.

1990 to 1992

#### **Golder Associates**

#### **Mt. Laurel, New Jersey**

*Project Engineering Geologist.*

Over two year involvement in the Remedial Design at the Industri-Plex site (No. 5 on the NPL) which included task leader of several Pre-Design Investigation tasks, lead cap designer, preparation of bid documents and specifications, and costs and quantity estimates for over 20 individual landowners.

Project engineer for the design of a 115 acre clay mine in New Jersey which included geotechnical and hydrogeologic field investigations, extensive laboratory testing program; design aspects related to hydrology, slope stability, phase sequences and cut volumes; and preparation of New Jersey Soil Erosion and Stream Encroachment Permit applications.

1987 to 1990

#### **Golder Associates**

#### **Mt. Laurel, New Jersey**

*Staff Engineering Geologist.*

Heavily involved in site investigations and construction oversight related to various solid waste and environmental restoration projects. Site investigations include a preliminary investigation at a abandoned coal mine in western Pennsylvania; and a detailed geologic and hydrogeologic investigation in support of a PADER Phase I permit at an abandoned coal mine in central Pennsylvania. Construction oversight includes a 2.25 acre closure cover at the Western Sand and Gravel Superfund site in Rhode Island and 17.0 acre slope cap for a municipal waste landfill expansion in central Pennsylvania.

Estimated construction costs and quantities for a four acre and two 80 acre expansions at the G.R.O.W.S. landfill in eastern Pennsylvania.

## Robert J. Illes

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1985 - 1987	<b>Kent State University</b> <i>Teaching Assistant.</i> Undergraduate geology laboratory instructor and soil mechanics laboratory technician.	<b>Kent, Ohio</b>
1985 - 1986	<b>Solar Testing Labs</b> <i>Summer Engineering Aide.</i> Soil and concrete laboratory and field testing and inspection.	<b>Garfield Heights, Ohio</b>

### PUBLICATIONS

Illes, R.J., Shakoor, A., "A Geotechnical Evaluation of Abandoned Strip Mines for Sanitary Landfill Purposes," GSA Abstracts, Volume 19, Number 1, January 1987.

Illes, R.J., Shakoor, A., "Geotechnical and Hydrogeological Evaluation of Abandoned Strip Mines for use as Sanitary Landfills," Abstracts and Program AEG Annual Meeting, October 1988.

Illes, R.J., Shakoor, A., "A Geotechnical Investigation of Abandoned Strip Mines for Sanitary Landfill Purposes," Bulletin of the Association of Engineering Geologist, Vol. XXVI, No. 4, 1989, pp. 501-519.

## Randolph S. White



**Education** B.S., Civil Engineering, University of Maine, Orono, 1981

**Affiliations** Registered Professional Engineer, New York

### **Experience**

1991 to date **Golder Associates Inc.** **Mt. Laurel, NJ**

*Project Director and Associate.*

Senior technical and management responsibility for CERCLA, RCRA, and State lead sites including RI/FS, RD/RA, treatability studies, human health and environmental risk assessment, and site remediation strategy development and agency negotiations. As a Project Manager, led the performance of a complex pumping test and groundwater extraction system design at a major CERCLA site; implemented RI and IRM (cap repair, leachate management) activities at a CERCLA site in Pennsylvania, provided technical leadership for the RD of a groundwater treatment system at a CERCLA site in New Jersey; assisted Risk Assessment and managed the Feasibility Study for a landfill site in New Jersey supporting a natural attenuation/no further action alternative, and managed the risk assessments and feasibility studies for two CERCLA sites in Pennsylvania. As Senior Engineer, conducted the evaluation of landfill leachate and mine drainage treatment systems which included treatment process evaluations, discharge permitting (NPDES) and cost estimating, designed and managed the performance of a groundwater treatability test for a CERCLA site in Ohio and subsequently evaluated and selected groundwater treatment system design modifications.

Also conducted Phase I and II Environmental Site Assessments in support of property transaction and conducted regulatory compliance analyses at various active industrial sites (RCRA, UST, ECRA/ISRA, Air, NPDES).

1985 - 1991 **Environmental Resources Management** **NJ & NY**  
*Senior Engineer.*

Experience includes: performance of senior engineering and project management functions for numerous industrial clients; site remediation strategy planning, risk assessment, Feasibility Studies and remedial action plan report preparation; soil and groundwater treatment process evaluation; regulatory negotiations of cleanup strategies; preparation of technical specifications and bid documents for site remediation projects; remedial construction oversight; design, management, and implementation of site investigation plans; active facility and site remediation permits (air, NJPDES, RCRA, construction); environmental regulation compliance analyses; and facility compliance audits.

Select projects include site investigation and Feasibility Studies for a large soil and groundwater cleanup of a New Jersey manufacturing site. Benchscale studies were conducted to select appropriate technologies. Pump tests, groundwater modeling, and risk assessments were performed. On-site pilot studies were conducted for an innovative recovery trench installation technique, chemical oxidation groundwater treatment, and heavy metals removal. Full scale system was designed, built, and is currently operating.



## Randolph S. White

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Also responsible for conducting Feasibility Studies and developing a remedial action plan for another large investigation and cleanup of a chemical manufacturing plant. Benchscale treatability studies and desk top engineering evaluations were used to select soil and groundwater remedial technologies. Biotreatability pilot studies were developed. The ECRA cleanup plan was negotiated with and approved by the NJDEP and is currently being implemented. Project Manager or Project Director of several remedial investigations conducted for sites in New Jersey. The work included the design and implementation of remedial investigations of groundwater, soil, surface water, sediment, and ecological habitats. Close negotiations with NJDEP were also conducted to obtain approvals of various report submittals.

1981 - 1985

### **New York State Department of Environmental Conservation**

*Project Engineer.*

Conducted RCRA facility inspection and permit reviews; municipal landfill inspections; site investigation and remedial action plan development/oversight; air pollution source emission monitoring protocol development; air pollution source permitting and controls evaluation, and stack tests.

## Stuart D. Mitchell



<b>Education</b>	B.S., Geology, University of Wyoming, 1986
<b>Affiliations</b>	Registered Professional Geologist, Tennessee Member, National Ground Water Association
<b>Certifications</b>	Certified Subsurface Evaluator, New Jersey Eight Hour Hazardous Waste Supervisor's Health and Safety Training Eight Hour Hazardous Waste Site Investigation Refresher Course Eight Hour Troxler Training Course for the use of Nuclear Testing Equipment 40 Hour Health and Safety Training Course
<b>Experience</b>	
1991 to date	<b>Golder Associates Inc.</b> <b>Mt. Laurel, New Jersey</b> <i>Project Manager, formerly Staff Hydrogeologist then Project Hydrogeologist.</i> Current responsibilities include: groundwater monitoring well installation and decommissioning, environmental sampling, completion and analysis of pumping tests and slug tests, geologic and hydrogeologic interpretation and technical report writing. Specific project experience includes preparation of Remedial Investigation/Feasibility Study Work Plans for Superfund Sites, environmental sampling at Superfund Sites in USEPA Regions I and II, evaluation of groundwater and groundwater remediation systems, and addressing environmental compliance issues related to USEPA, PADER and NJDEP regulations.
1986 - 1991	<b>New Jersey Department of Environmental Protection</b> <b>Trenton, New Jersey</b> <i>Hydrogeologist.</i> Responsibilities involved the technical review of geologic and hydrogeologic reports and environmental sampling plans in support of the Environmental Cleanup Responsibility Act (ECRA), including: the evaluation and design of groundwater monitoring well systems in unconsolidated and diverse bedrock, such as fractured shale, sandstone and igneous formations. Evaluation of sources for groundwater contamination, groundwater monitoring well placement and construction, packer and pump tests and groundwater remediation programs to recover and prevent the migration of hazardous wastes, solvents and petroleum products. Evaluation of Environmental Sampling Plans and the on-site oversight of the implementation of the Plans. Performed the geochemical review of groundwater quality data and the writing of New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Groundwater Permits.
1980-1986	<b>South Dakota Geological Survey (Seasonal Employment)</b> <b>Vermillion, S. Dakota</b> <i>Assistant Geologist.</i> Responsibilities involved the supervision of geologic and hydrogeologic investigations, including: exploratory drilling, groundwater monitoring well installation, groundwater monitoring well sampling and geophysical logging.

## Mark D. LaGatta



**Education** M.S., Civil Engineering, The University of Texas, Austin, Texas, 1992  
B.S., Civil Engineering, Bucknell University, Lewisburg, Pennsylvania, 1987  
OSHA 40-hour Health & Safety Trained in Hazardous Waste Site Investigation

**Affiliations** Member, American Society of Civil Engineers  
Registered Professional Engineer in Pennsylvania

### Experience

1992 to date

#### **Golder Associates**

**Mt. Laurel, New Jersey**

*Project Engineer, formerly Geotechnical Engineer.*

Participation in full-range of activities for Pre-Design Investigation (PDI) for failed solid waste disposal site in Old Bridge township, New Jersey -- supervised complex geotechnical investigation which included in-situ vane shear tests and cone penetration tests with pore pressure measurement (CPTU) in addition to installation of inclinometers; performed CPTU interpretations and engineering (*viz.*, slope stability) analyses; coordinated laboratory soils testing program; and, assisted with report preparation. Prepared opinion of cost, bill of materials, assisted with construction drawings and specifications for an 18-acre lateral expansion to an existing solid waste facility in Lancaster and Chester Counties, Pennsylvania; continued involvement with the Lanchester facility during the construction phase reviewing contractors' submittals and effecting technical clarifications/amendments.

Provided technical assistance in support of focused feasibility study for remediation of a chromium-contaminated site in Queens Village, New York and revised feasibility study addressing ammonia detected in groundwater at a site in Dade County, Florida. Involved with the preparation of remedial pre-design plans for Dover Municipal Landfill (Superfund) in Strafford County, New Hampshire; work included Project Operations Plan, Pre-Design Work Plan, and Environmental Monitoring Plan.

Performed static slope stability analyses of natural materials and geosynthetic liner systems for various municipal solid waste and ash monofill facilities. Executed static and/or dynamic stability analyses with estimate of displacement(s) within lining system for planned expansion to the City of Unalaska's municipal solid waste landfill located in the Aleutian Islands, Alaska and the Durham Region Landfill Site Search, Canada.

Provided construction quality control/assurance services during the deployment of 10 acres of geosynthetic materials in liner and cap systems of three solid waste disposal facilities located in southeastern Michigan. Performed field inspection, managed laboratory testing, and assisted with foundation recommendations relating to subsurface investigations for commercial office/warehouse buildings and above-grade pipe line supports.

1990 - 1992

#### **University of Texas**

**Austin, Texas**

*Teaching Assistant/Research Assistant.*

Responsible for preparing and presenting soil mechanics laboratory lectures, equipment operation, grading reports, and student consultations. Designed research apparatus and implemented bench-scale testing program to study the influence of differential settlement on the hydraulic conductivity of hydrated geosynthetic clay liners (GCLs), both intact and overlapped seam specimens. Conducted laboratory compaction, permeability, and Atterberg limit testing for two smaller supplemental research projects, i.e., cross-linked polyacrylamide soil amendment and calcium montmorillonite source feasibility.

## Mark D. LaGatta

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1988 - 1990      **Greiner Engineering, Inc.**      **King of Prussia, Pennsylvania**

*Design Engineer.*

Performed design work pertaining to limited access and arterial roadways such as geometry layout, drainage design, pavement specification, traffic studies, and bid/construction document preparation. Larger-scale projects worked on included completion of I-76/I-476 (Blue Route), improvements to I-95/S.R. 63 (Woodhaven Road), and completion of I-95/I-90 (Betsy Ross Bridge) interchanges. Extensive field assignments on various projects which involved remedial grouting of bedrock and overburden for sinkhole stabilization, exploratory drilling for the remediation of a 60-ft rock cut, and test boring/rock coring for roadway structure foundation recommendations. Field work included contract management, contractor and utility coordination, and subsequent preparation of plans and reports.

1987 - 1988      **R.K.R. Hess Associates, Inc.**      **Stroudsburg, Pennsylvania**

*Design Engineer.*

Designed drainage facilities and roadways, developed erosion and sedimentation control plans, and completed permit applications relating to land development and subdivision work. Inspected 46 steel, concrete, and stone masonry bridges carrying county and township roadways; responsible for preparation of proposal, control of budget/billing, recommendation on weight restriction postings when necessary, and submittal of final reports. Supervised hydrostatic and mandrel tests on flexible sewer line to measure pipe deflection for township approval and similarly oversaw the video inspection of ACP sewer line to locate possible sources of infiltration. Assisted with annual inspection of three low-head ( $\leq 20$  ft. high) earth-fill dams having a crest length of about 500 ft. Supervised and provided construction QA/QC services for reconstruction of 200-ft.-long, ogee crest spillway of 10-ft.-high earth embankment dam; duties included inspection of earthworks for spillway subgrade and adjacent embankment as well as inspection of concrete work related to field-cast ogee weir.

1985 - 1986      **Carr Dee Test Boring Corp.**      **Medford, Massachusetts**

*Assistant Driller.*

Worked on a variety of drill rigs performing various subsurface exploration techniques. Performed the SPT in sands and clays, took rock cores, and installed groundwater monitoring wells.

### Publications

LaGatta, M.D. (1992), "Hydraulic Conductivity Tests on Geosynthetic Clay Liners Subjected to Differential Settlement," Master of Science Thesis, University of Texas at Austin, 120 pp.

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PROFESSIONAL PROFILE

**JESSE R. CONNER**  
Consultant

**Education:**

B.S., 1954, Chemistry (Honors), Carnegie-Mellon University  
A.A.S., 1951, Photographic Technology, Rochester Institute of Technology  
40-Hour OSHA 29 CFR 1910.120, 1992  
8-Hour OSHA Annual Refresher, 1992, 1993, 1994  
First Aid and CPR Training, 1990

**Current Expertise:**

Presently a consultant in Pittsburgh, Pennsylvania, Mr. Conner has been active in research, testing, commercial development, operation and management of hazardous waste treatment since 1968, and is a recognized expert in waste stabilization and fixation. He co-founded several remedial stabilization companies, was responsible for stabilization technology and development for a major international hazardous waste services company, and since retirement, consults with many organizations in this area.

**Relevant Experience:**

**Chemical Waste Management, Inc./Rust Remedial Services** *August 1987 - March 1994*  
**Senior Research Scientist.** Responsible for stabilization technology and development for Chemical Waste Management, Inc. and Rust Remedial Services, Inc. (RRS) including: development of fixed, batch mixing systems for central TSD's; regulatory review and interaction with the USEPA on stabilization technology; evaluation and development of new and innovative stabilization/fixation systems for next-generation "Land Ban" requirements, including organic stabilization; consulting within RRS and with customers; supervising treatability studies on stabilization/fixation.

**Consultant, Atlanta, Georgia** *June 1985- July 1987*  
As a consultant, designed a system to provide computerized formulations for specific waste streams and disposal situations, performed treatability studies, and developed new stabilization technology for various clients in the hazardous waste management field.

**Chem-Technics, Inc., Atlanta, Georgia** *September 1983 - May 1985*  
**Co-founder. Vice President/Technical Director.** Designed solidification facilities, selected solidification/fixation processes, and developed optimum overall hazardous waste treatment systems. His duties included: supervising corporate development of new stabilization and spill control products and processes; treatment and detoxification of organic solvents, fuels and priority pollutants; planning and executing a computerized treatability database to minimize laboratory testing of routine samples.

**SolidTek, Inc., Atlanta, Georgia** *January 1979 - August 1983*  
**Co-founder. President.** Planned and executed the formation of SolidTek, a chemical solidification/fixation business, for an investment group. Additionally, he assembled an operations and marketing staff, built central waste processing center, designed and built mobile treatment equipment and a laboratory. His activities included work with the US EPA and the state regulatory agencies to qualify SolidTek and its processes and systems for use the Resource Conservation and Recovery Act (RCRA), and also writing one of the early Part B permit applications for a central TSD facility.

***Consultant, Pittsburgh, Pennsylvania***

***February 1977- December 1978***

Mr. Conner specialized in chemical solidification/fixation. He conducted market studies in this area, and in the areas of publicly-owned treatment works grant programs and applications for process filter media in the pollution control market, as well as assembling a unique database utilizing the results of thousands of tests in hundreds of different waste streams.

***Chemfix, Inc., Pittsburgh, Pennsylvania***

***June 1968 - January 1977***

Co-founder, President. President and co-founder of this firm where he: set up laboratories and information systems; consulted in environmental testing and control; initiated and conducted research programs which resulted in the "Chemfix" process. He developed the solidification process into a commercial business supplying the first broad spectrum chemical fixation service. Under his leadership, "Chemfix" was established as the best known name in the field with the completion of on-site stabilization projects at more than 100 remedial projects in the US, England, France, Japan and Canada. He also conducted licensing activities in the United States, Europe, and Japan.

**Continuous Years of Relevant Experience: 26 years**

**Awards, Honors and Memberships:**

Winner of the "IR-100 Award", 1970 and the "John C. Vaaler Award" (Chemical Engineering Magazine), for the (Chem-Fix) process. Member of ACS, ASTM, NACE, HMCRI societies.

**Authorship of Relevant Technical Articles and Patents:**

About 20 technical papers and 30 patents in this field, numerous technical presentations; author of one book on chemical fixation and solidification (published by Van Nostrand Reinhold) and chapters in several other recent books.

**CARL P. SWANSTROM**

**Chemical Engineer  
Center for Environmental Restoration Systems  
Energy Systems Division  
Argonne National Laboratory**

Mr. Swanstrom has a B.S. Ch.E. from Illinois Institute of Technology and over 25 years of experience. His most recent experience has focused on project management and process design in hazardous waste management. While employed with Chemical Waste Management (CWM), he developed the patented contaminated soil thermal desorption process known as X\*TRAX. Carl was responsible for the entire project from concept development through full scale commercialization including all required permitting. The X\*TRAX process is the only operating full scale indirect heated - off gas condensing thermal desorber demonstrated in the US to reduce PCBs to less than 2 ppm in soil.

While with CWM Carl designed and constructed three drum decanting facilities for organic wastes. He developed and implemented processes for treating 27,000 gallons of acid solubilized oil (ASO) containing hydrofluoric acid, 400 drums and 2,000 yards of water reactive solids and 8 million gallons of water containing chelated nickel. All Federal and State permits submitted under his supervision have been granted. In 1983-84, he was Technical Director of ECOL in Buenos Aires responsible for the design of a comprehensive hazardous waste treatment facility for Argentina. Carl has also performed numerous technology reviews for potential acquisitions or joint ventures.

Mr. Swanstrom has extensive experience in the areas of thermal treatment of solids, material handling of solids, classical filtration, membrane filtration (RO, UF and microporous), ozone/UV treatment of contaminated water, RCRA/TSCA permitting and regulations and mixed waste (RCRA/radioactive) processing.

*September 1994*

**CARL P. SWANSTROM**  
**Chemical Engineer**  
**Center for Environmental Restoration Systems**  
**Energy Systems Division**  
**Argonne National Laboratory**

**Educational Background**

**1968: B.S.Ch.E., Illinois Institute of Technology, Chicago, Illinois**

**Professional Experience**

**1994 to Present Argonne National Laboratory - Chemical Engineer**

Performs research and development projects relating to thermal remediation processing, dewatering of waste streams, and waste minimization and reduction. Evaluates and designs operating parameters for waste remediations systems at bench, pilot, and full scale. Evaluates and selects air quality monitoring equipment, trains for quantifying the success of remediation processes. Develops Data Quality Objectives for demonstrating systems' effectiveness with high quality data. Designs and modifies feed systems for pilot and full scale remediation systems. Provides technical review and support on remediation process research relating to thermal systems, physical/chemical systems, and reduction systems for contaminated soil and water.

**1993-1994: Private Consultant**

Most of the consulting has been for the Waste Management Family of Companies. Supported marketing and full-scale implementation of X\*TRAX for on-site thermal remediation with the RUST Remedial Services Clemson Technical Center (CTC) in South Carolina. Also performed numerous technology evaluations for CTC. From June to December of 1993, I was acting plant manager for the ATM paint waste treatment plant in Holland, working under a contract with Waste Management International. The facility was in start-up for almost a year when I arrived. In five months, I tripled the plant capacity, reduced operating costs by 55% and eliminated one million dollars of planned capital improvements.

**1981-1993: Senior Project Manager, Chemical Waste Management**

Started with Corporate R&D shortly after its formation. Moved to Corporate Engineering in 1985 for one year when R&D operations were temporarily suspended. Returned to R&D in 1986 which was changed to Engineering and Technology (E&T) in 1991. Managed projects ranging from \$50,000 to \$10 million with a staff of up to seven professionals. Significant projects are outlined below:

- Developed a thermal desorption process (X\*TRAX) for the remediation of contaminated soil from concept to full-scale commercial operation. Responsible for entire project including design, construction, testing and operation of



laboratory, pilot and full-scale systems. Three patents have been granted to date. The full scale system exceeded both the design throughput and removal efficiency in its first operation. The laboratory scale system is still in operation performing treatability studies.

- As Technical Director, lived in Buenos Aires for five months to design a full-scale comprehensive hazardous waste treatment facility for the country of Argentina. Managed facility design, preparation of all facility operation plans and required government submittals.
- Spent one month in Madrid, Spain. to manage treatment facility design for proposal with Spanish partner.
- Safely designed and operated a system to treat 28,000 gallons of oil containing hydrofluoric acid. Several previous attempts over a period of 18 months to manage this material were unsuccessful. Entire project completed in less than three months, including disposal of the containers.
- Designed and started up process to safely and economically treat 5,000 cubic yards of reactive metals. Previous attempts to treat this waste had been unsuccessful.
- Designed, managed construction and put in to operation a \$1 million treatment plant to process nine million gallons of pond water containing chelated nickel. The company faced fines of \$10,000 per day if water was not treated by set date. Treatment completed one week ahead of schedule and within budget.
- Designed process for decanting organics from drums, recovering the organic liquid and stabilizing the residual in the emptied drum so it could be disposed of. Process installed at several sites.

**1976-1981: Senior Project Leader, Beatrice Foods Research Center**

Primary emphasis on new process and product development. Had opportunity to develop projects from laboratory scale to full scale. Developed process for producing natural red color from beets in response to ban on Red #4 dye in food products. Went from laboratory-scale testing to full-scale production in 18 months. Gained valuable experience in membrane (ultra-filtration) processing. Plant paid for itself in six months. Also responsible for evaluation of the natural color in various food products. Developed process for using ultra-filtration to produce a high protein concentrate from cheese whey. Evaluated and modified new rapid process for producing fermented soy sauce. Designed facility for producing a spray dried coconut powder.

**1968-1981: Associate Chemical Engineer, IIT Research Institute**

Contract research for industrial clients and governmental agencies. Opportunity to be exposed to many engineering disciplines. Required development of excellent technical writing skills and the ability to work with multiple groups within a single organization while operating under very tight budget constraints.

- Fine Particle Testing
- Pilot Explosive Production
- Packed Scrubber Evaluation
- Detergent Formulation
- Wastewater Monitoring
- Stack Sampling
- Odor Measurement
- Ozone/UV Waste Treatment

**Awards** Recipient of the first Waste Management "President's Award for Technical Excellence" in 1988 for the X\*TRAX Treatment System.

**Patents** Four U.S. Patents: 4,697,467; 4,864,942; 4,977,839; 5,253,597.

**Papers** Numerous technical papers. (List available)

Co-author of *Thermal Desorption*, Chapter in Hazardous Waste Site Soil Remediation: Theory and Application of Innovative Technologies published by Marcel Dekker (1994).

Guest speaker at Soils Remediation Course. Invited for second time.

**Affiliations** American Institute of Chemical Engineers (AIChE)  
Hazardous Materials Control Resources Institute (HMCRI)  
Air & Waste Management Association (AWMA)

**MARY F. DEFLAUN, Ph.D.**

**CURRENT POSITION**

Envirogen, Inc., Lawrenceville, NJ

Applications Manager, Bioremediation Technologies

Responsible for field demonstration and commercialization of bioremediation technologies resulting from Envirogen's Technology Development Program.

**EXPERIENCE**

Envirogen, Inc., Lawrenceville, NJ

Manager, Advanced Biocatalysis Program (1992-1994)

Responsible for implementing R&D programs related to the development of in situ hazardous waste treatment processes.

Research Scientist, Advanced Technology Group (1990-1992)

Responsible for cloning and optimizing expression of genes responsible for the biodegradation of trichloroethylene (TCE), and polychlorinated biphenyls (PCBs).

Tufts University Medical School, Boston, MA (1987-1990)

Postdoctoral Research Associate

Under the direction of Dr. Stuart B. Levy, performed research on the characterization and cloning of genes expressing adhesion in soil *Pseudomonads*. Studied the survival traits of motile and non-motile soil bacteria in laboratory soil microcosms; devised an assay to identify bacterial adhesion variants.

University of South Florida, St. Petersburg, FL (1984-1987).

Research Assistant,

Performed research related to the dynamics of dissolved DNA in the marine environment. Also performed analyses of hydrodynamic flume-generated physical oceanographic data.

Case Western Reserve University, Cleveland, OH (1982-1983).

Research Assistant/Associate

Studied in situ growth rates of sediment bacteria as part of a NOAA research project investigating Lake Erie.

University of Maine, Orono, ME (1980-1982).

Graduate Research Assistant

Performed a scanning electron microscopy study of bacterial attachment to intertidal sediments.

Graduate Teaching Assistant

Freshman biochemistry course.

U.S. Department of Commerce, Washington, D.C. (1980).

Consultant, National Marine Fisheries

Collected data for a recreational fisherman's catch survey.

## EDUCATION

University of South Florida, St. Petersburg, FL

Ph.D., Oceanography, 1987

University of Maine, Orono, ME

M.S., Oceanography, 1982

Beloit College, Beloit, WI

B.S., Biology, 1978

## HONORS AND PROFESSIONAL AFFILIATIONS

American Association for the Advancement of Science

American Society for Microbiology

Society for Industrial Microbiology

Dean's List, Beloit College, 1977

Graduate Council Fellowship, USF, 1983 and 1984

Gulf Oceanographic Foundation Fellowship, 1984 and 1985

Phi Kappa Phi, 1985

Lake Fellowship, USF, 1986

## PUBLICATIONS

Ensley, B.D. and M.F. Del'laun. 1995. Hazardous chemicals and biotechnology: Past successes and future promise. In L. Young and C. Cerniglia (eds.) *Microbial Transformation and Degradation of Toxic Organic Chemicals*. pp. 519-619. Wiley-Liss, New York.

Del'laun, M.F., C.W. Condee and B.D. Ensley. 1994. Enhanced transport of degradative bacteria for in situ bioremediation. In: "In Situ Remediation: Scientific Basis for Current and Future Technologies" Thirty-Third Hanford Symposium on Health and the Environment. Nov 7-11 Pasco, Washington.

Del'laun, M.F., B.M. Marshall, E.P. Kelle and S.B. Levy. 1994. Tn5-insertion mutants of *Pseudomonas fluorescens* defective in adhesion to soil and seeds. *Appl. Environ. Microbiol.* 60: 2637-2642.

Lajoie, C.A., G.J. Zylstra, M.F. Del'laun and P.F. Strom. 1993. Field Application Vectors for Bioremediation of Soils Contaminated with Polychlorinated Biphenyls (PCBs). *Appl. Environ. Microbiol.* 59:1735-1741

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Paul, J.H., L.H. Cazares, A.W. David, M.F. DeFlaun and W.H. Jeffrey. 1991. The distribution of dissolved DNA in an oligotrophic and an eutrophic river of southwest Florida. *Hydrobiologia*. 218:53-63.

Jeffrey, W.H., J.H. Paul, L.H. Cazares, M.F. DeFlaun and A.W. David. 1990. Correlation of non-specific macromolecular labeling with environmental parameters during [<sup>3</sup>H] thymidine incorporation in the waters of southwest Florida, *Microbial Ecology*. 20:21-35.

DeFlaun, M.F., A. Tanzer, A. McAtcer, B. Marshall, and S.B. Levy. 1990. Development of an adhesion assay and characterization of an adhesion deficient mutant of *Pseudomonas fluorescens*. *Applied and Environmental Microbiology*. 56:112-119.

DeFlaun, M.F. and S.B. Levy. 1989. Genes and their varied hosts, p. 1-32. In S.B. Levy and R.V. Miller (eds.), *Gene Transfer in the Environment*. McGraw Hill, NY.

Paul, J.H., W.H. Jeffrey, A.W. David, M.F. DeFlaun, and L.H. Cazares. 1989. Turnover of extracellular DNA in eutrophic and oligotrophic freshwater environments of southwest Florida. *Applied and Environmental Microbiology*. 55:1823-1828.

DeFlaun, M.F. and J.H. Paul. 1989. Detection of exogenous gene sequences in dissolved DNA from aquatic environments. *Microbial Ecology*. 18:21-28.

Paul, J.H., M.F. DeFlaun, and W.H. Jeffrey. 1988. Mechanisms of DNA utilization by estuarine microbial populations. *Applied and Environmental Microbiology*. 54:1682-1688.

Paul, J.H., M.F. DeFlaun, W.H. Jeffrey and A.W. David. 1988. Seasonal and diel variability in dissolved DNA and in microbial biomass and activity in a subtropical estuary. *Applied and Environmental Microbiology*. 54:718-727.

DeFlaun, M.F., J.H. Paul, and W.H. Jeffrey. 1987. The distribution and molecular weight of dissolved DNA in subtropical estuarine and oceanic environments. *Marine Ecology Progress Series*. 38:65-73.

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DeFlaun, M.F., J.H. Paul, and D. Davis. 1986. Simplified method for dissolved DNA determination in aquatic environments. *Applied and Environmental Microbiology*. 52:654-659.

DeFlaun, M.F. and J.H. Paul. 1986. Hoechst 33258 staining of DNA in agarose gel electrophoresis. *Journal of Microbiological Methods*. 5:265-270.

Paul, J.H., W.H. Jeffrey and M.F. DeFlaun. 1985. Particulate DNA in subtropical oceanic and estuarine planktonic environments. *Marine Biology*. 90:95-101.

DeFlaun, M.F. and L.M. Mayer. 1983. Seasonal characterization of sediment bacteria in an intertidal mudflat. *Limnology and Oceanography*. 28:873-881.

DeFlaun, M.F. 1982. Sedimentology photograph. *Journal of Sedimentary Petrology*. 52:226.

#### **PATENTS**

Electrokinetic Transport of Microorganisms In Situ For Degrading Contaminants. Patent Application Filed, 11/92.

#### **INVITED LECTURES and REVIEW BOARDS**

Development of an Adhesion Assay and Identification of Genes in *Pseudomonads* Involved in Adhesion to Soil. Gordon Research Conference on Applied and Environmental Microbiology. New London, NH. July 24-28, 1989.

Strategies and Mechanisms for Field Research in Environmental Bioremediation. American Academy of Microbiology Colloquium. January 8-10, 1993, San Antonio, TX.

In Situ Applications of Genetically-Modified Microorganisms for the Degradation of Recalcitrant Contaminants. Presented at the 7th International Symposium on the Genetics of Industrial Microorganisms. June 26-July 1, 1994. Montreal, Canada.

Selection of Degradative Bacteria with Enhanced Transport Properties for In Situ Bioremediation. The Annual Meeting for the Society for Industrial Microbiology. July 31-August 5, 1994. Boston, Massachusetts.

Enhanced Transport of Degradative Bacteria for In Situ Bioremediation. In Situ Remediation: Scientific Basis for Current and Future Technologies, November 7-11, 1994, Pasco, WA.

Selecting Strains for Bioaugmentation: Enhanced Transport Properties. The Third International In Situ and On-Site Bioreclamation Symposium. San Diego, CA, April 24-27, 1995.

Peer Reviewer for the Subsurface Science Program for the Department of Energy, Office of Energy Research.

Member of the Advisory Board for the Biotechnology Exhibit for the Franklin Institute of Science-Philadelphia

**APPENDIX B**

**Sampling, Analysis and Monitoring Plan**

**APPENDIX B**

**SAMPLING, ANALYSIS AND MONITORING PLAN  
FOR OFF-PROPERTY INVESTIGATION  
216 PATERSON PLANK ROAD SITE  
CARLSTADT, NEW JERSEY**



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<b>Attachment B5</b>	<b>General Sampling Procedures</b>

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## 1.0 INTRODUCTION

This Sampling, Analysis, and Monitoring Plan (SAMP) has been prepared as part of the Work Plan Amendment (Work Plan) to perform an additional Off-Property Investigation (Investigation) at the 216 Paterson Plank Road Site (Site) in Carlstadt, Bergen County, New Jersey. The purpose of this SAMP is to identify and describe investigation and sampling and analysis procedures for the Investigation.

The general activities which comprise the Investigation are as follows:

- Installation of pressure transducers in select monitoring wells and a Steven's recorder-type device (or equivalent) in Peach Island Creek to monitor long-term water level fluctuations;
- Completion of one deep bedrock pilot borehole;
- Installation of four bedrock monitoring wells (MW-8R, MW-10R, MW-11R, and MW-14R), four wells screens within till/weathered bedrock (MW-10D, MW-14D, MW-15D, and MW-16D), and one well each in the till (MW-17D) and weathered bedrock (MW-18D) at off-property locations;
- Conduct hydrogeologic testing in the newly installed monitoring wells;
- Collection of groundwater samples from the newly installed monitoring wells;
- Collection of groundwater samples for PCE and TCE "fingerprint compounds" at two depths in existing monitoring wells MW-5D, MW-7D, and MW-11D;
- Conduct borehole geophysical testing in existing and select newly installed monitoring wells; and,
- Other field procedures required to completed the items above (e.g., decontamination, water level measurements, etc.).

The rationale for these activities is presented in the Work Plan and the remainder of this SAMP contains detailed procedural information regarding; drilling and well installation; hydrogeologic testing; groundwater sample collection; and, field measurements and decontamination procedures.

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## **2.0 DRILLING AND WELL CONSTRUCTION AND DEVELOPMENT PROCEDURES**

### **2.1 Decontamination and Waste Handling**

Before initiating any drilling activities the drill rig, drilling tools, and sampling equipment will be decontaminated as described in Section 6.0. An on-site decontamination pad will be constructed at the approximate location shown in Figure B1. Solids will be separated and stored in D.O.T. approved 55-gallon drums and staged on-Site for subsequent disposal as Investigation Derived Waste. Liquids will be collected and pumped into the existing on-Site 10,000 gallons holding tank. Potable water from a local municipal water supply will be used for all drilling activities (e.g. steam cleaning, decontamination, drilling mud, etc.) unless an alternative water source is approved by the USEPA. A sample of the water used during the drilling process will be collected and analyzed (TAL/TCL parameters). Drill cuttings and drilling fluids will be placed in D.O.T. approved 55-gallon drums, labeled, and transported to the 216 Paterson Plank Road Site where they will be staged for subsequent disposal as Investigation Derived Waste. Well development water will be discharged to D.O.T approved 55-gallon drums, labeled, and transported to the 216 Paterson Plank Road Site where they will be pumped into the existing on-Site 10,000 gallon holding tank for off-site treatment and disposal.

### **2.2 Pilot Bedrock Borehole and Monitoring Well Drilling Procedures**

Boreholes will be drilled and monitoring wells constructed and developed by a New Jersey licensed well driller, and supervised by a geologist or engineer qualified by education and experience. The driller will obtain the permits required to drill and install each well from the NJDEP Well Drilling Permit Section. Soil and rock samples will be examined by the field geologist or engineer supervisor who will maintain a descriptive log for each boring. Additionally, the field supervisor will direct installation activities and document well construction and development activities. All well drilling activities will follow the Health and Safety Plan (HASP) provided in Appendix D.

#### **Bedrock Pilot Borehole/Monitoring Well MW-8R**

The borehole for installing monitoring well MW-8R will be completed in several stages. First, a 14-inch diameter borehole will be advanced a minimum of one foot into the glaciolacustrine varved unit (confining unit) using hollow stem auger drilling techniques. A 10-inch diameter steel casing will be

driven a minimum of one foot below the drilled borehole. The annulus between the borehole and the casing will be grouted using cement-bentonite grout placed using the tremie method. All grouting and sealing mixtures will be in accordance with the NJDEP Field Sampling Procedures Manual (May 1992). A mud balance will be used to determine the target density for the mixture and the results will be recorded on the monitoring well installation logs. A minimum of twelve hours after the 10-inch steel casing is installed, fluid within the casing will be flushed out. Second, a 9-5/8-inch borehole will be advanced through the glaciolacustrine varved unit, till, and weathered bedrock units using wash rotary drilling techniques (mud will be used only if necessary). Rotary drilling techniques are proposed because it is not possible to drill through the 10-inch steel casing with hollow stem augers.

Soil samples in the overburden will be taken (in general conformance with ASTM D-1586) by driving a 2-inch outside diameter (OD) split-spoon sampler, a distance of 2 feet ahead of the boring into undisturbed material at continuous intervals, beginning at ground surface, to bedrock. Blow counts required to drive the split-spoon each 6-inch increment will be recorded. The total recovery of the samples will be measured and the soil classified using the Unified Soils Classification System (USCS) based on visual description only. Soil samples will be field monitored for the potential presence of VOCs using a PID. Readings will be recorded on the boring logs and daily field logs provided in Attachments B1 and B2.

The top ten feet of competent bedrock will then be cored with HQ diamond-bit core barrel with wireline setup and the corehole will be reamed using either wash or air rotary (9-5/8-inch diameter borehole). A 6-inch steel casing will then be set in the top ten feet of competent rock and the casing will be grouted with a cement-bentonite grout using the tremie method. A minimum of twelve hours after the 6-inch steel casing is installed, fluid within the casing will be flushed out and the next 40 feet of bedrock will be cored with HQ diamond-bit core barrel with wireline setup. Five-foot (5) core runs through the bedrock will be conducted. The total maximum thickness of the coring including the top ten feet will be 50 feet. Borehole geophysics will be performed as described in Section 3.1 and Attachment B3. The cored borehole will then be packer tested as described in Section 3.3 and in accordance with Attachment B4.

To complete the installation of a monitoring well in the borehole, approximately the bottom 25-30 feet of the cored bedrock will be grouted with a cement-bentonite grout placed using the tremie method. The grout will be allowed to set for a minimum of 12-hours. The depth to top of grout will then be sounded

with a weighted tape measure and, if necessary, additional grout will be added. Once the top of grout depth has been achieved, the portion of the borehole between the bottom of the 6-inch steel casing and the top of grout will be reamed to 5-5/8-inches in diameter using wash or air rotary drilling techniques. A 2 foot thick layer of filter sand (fine grained sand pack) will be placed on top of the grout prior to the installation of the well screen and riser. Monitor well construction details are provided in Section 2.3. Exact depths will be determined in the field by the supervising geologist/engineer and USEPA oversight contractor.

### **Bedrock Monitoring Wells**

The boreholes for the remaining three bedrock monitoring wells (MW-10R, MW-11R, and MW-14R) will be advanced in several stages. First, a 12-inch diameter borehole will be advanced a minimum of one foot into the glaciolacustrine varved unit (confining unit) using hollow stem auger drilling techniques. An 8-inch diameter steel casing will be driven a minimum of one foot below the drilled borehole. The annulus between the borehole and the casing will be grouted using cement-bentonite grout placed using the tremie method. A minimum of twelve hours after the 8-inch steel casing is installed, fluid within the casing will be flushed out. Second, a 7-5/8-inch borehole will be advanced through the glaciolacustrine varved unit, till, and weathered bedrock units using wash rotary drilling techniques (mud will be used only if necessary). Rotary drilling techniques are proposed because it is not possible to drill through the casing with hollow stem augers.

Soil samples in the overburden will be taken (in general conformance with ASTM D-1586) by driving a 2-inch OD split-spoon sampler, a distance of 2 feet ahead of the boring into undisturbed material at continuous intervals, beginning at ground surface to bedrock. Blow counts required to drive the split-spoon each 6-inch increment will be recorded. The total recovery of the samples will be measured and the soil classified using the USCS based on visual description only. Soil samples will be field monitored for the potential presence of VOCs using a PID. Readings will be recorded on the boring logs and daily field logs provided in Attachments B1 and B2.

The top ten feet of competent bedrock will then be cored with HQ diamond-bit core barrel with wireline setup and the core hole will be reamed to 7-5/8-inch in diameter using either wash or air rotary. A 4-inch steel casing will then be set in the top ten feet of competent rock and the casing will be grouted using cement-bentonite grout using the tremie method. A minimum of twelve hours after the 4-inch steel

casing is installed, fluid within the casing will be flushed out and the next 10 feet of bedrock will be cored with HQ diamond-bit core barrel with wireline setup. Five-foot (5) core runs through the bedrock will be conducted. The total maximum thickness of the coring including the top ten feet will be 20 feet. The cored borehole will then be packer tested as described in Section 3.3 and in accordance with Attachment B3. The cored borehole below the 4-inch steel casing will provide the open borehole interval for the monitoring well. Monitor well construction details are provided in Section 2.3.

#### Till/Weathered Bedrock Monitoring Wells

A total of four wells will be screened within the till/weathered bedrock (MW-10D, MW-14D, MW-15D, and MW-16D) and one well each within the till (MW-17D) and weathered bedrock (MW-18D). These wells will be completed in two stages to the required depths. First, a 12-inch diameter borehole will be advanced a minimum of one foot into the glaciolacustrine varved unit (confining unit) using hollow stem auger drilling techniques. An 8-inch diameter steel casing will then be driven a minimum of one foot below the bottom of the drilled borehole. The annulus between the borehole and the 8-inch diameter casing will be grouted using cement-bentonite grout placed using the tremie method. A minimum of twelve hours after the 8-inch casing is installed, fluid within the casing will be flushed out. Second a 7-5/8-inch diameter borehole will be advanced to top of competent bedrock, or to the top of weathered bedrock in the case of MW-17D, using wash rotary drilling techniques (mud will be used only if necessary). Monitoring wells MW-10D, MW-14D, MW-17D, and MW-18D will be installed in the vicinity of a proposed bedrock well. Therefore sampling will only be conducted to verify geologic contacts. Continuous split spoon samples will be taken at locations MW-15D and MW-16D. Construction of the monitoring wells is described below in Section 2.3.

### **2.3 Monitoring Well Construction and Development**

#### Till/Weathered Bedrock Monitoring Well Construction

All well materials will be thoroughly steam-cleaned and placed on clean polyethylene sheeting prior to installation. Each monitoring well will be constructed with 4-inch ID, 304 stainless steel threaded casing and screen with water tight joints. The till/weathered bedrock wells (MW-10D, MW-14D, MW-15D, and MW-16D) will be screened within the most contaminated zone based on PID readings and visual observations during drilling. If no elevated readings and/or visual contamination is observed, the most permeable zone (based on visual assessment of split spoon



samples) will be screened with a maximum screen length of 10 feet. At the cluster formed by MW-17D and MW-18D, the same general approach will be used while ensuring that the upper (MW-17D) screen is solely in till and the lower (MW-18D) screen is solely in weathered bedrock. The depth and length of the screened interval and actual well construction details will be based on observation by the supervising field geologist/engineer and the USEPA oversight contractor. The well screen slot size will be 0.010 inch (No. 10 slot) which is a conservative slot size considering all existing wells are constructed with a 20-slot well screen and perform satisfactorily. Figure B2 illustrates the typical till/weathered bedrock monitoring well construction details.

A sand pack, comprised of clean quartz sand and chemically non-reactive, will be placed around the well screen and will extend a minimum of two feet above the top of the well screen. The sand pack material will be such that 90% by weight is larger than the screen slot size of 0.010 inch (consistent with previous well construction). A minimum of one foot of filter pack (fine-grained sand pack) will extend above the sand pack. No more than five feet of sand and filter pack (combined) will be used above the top of the well screen and the filter pack will not extend up into the glaciolacustrine varved unit or the glacial till in the case of MW-18D. A cement/bentonite grout (6%-10% bentonite) mixture will be pressure grouted with a tremie pipe (side discharge) from above the filter pack to ground surface. All grouting and sealing mixtures will be in accordance with the NJDEP Field Sampling Procedures Manual (May 1992). A mud balance will be used to determine the target density of the mixture and the results will be recorded on the monitoring well installation logs. The monitoring wells will be completed as flush mount wells. A protective steel casing equipped with a locking cap will be set approximately 3 feet below ground surface around the 4-inch stainless steel riser. The monitoring well number will be imprinted on the well cover lid. It should be noted that the construction of monitoring wells MW-17D and MW-18D will be modified so that as these wells will be completed solely in the till and weathered bedrock, respectively.

The monitoring wells will be developed in accordance with the NJDEP Field Sampling Procedures Manual (May 1992) and USEPA Monitoring Well Development Guidelines for Superfund Project Managers (April 1992). Each monitoring well will be developed using a combination of a surge block and submersible pump and will be developed until relatively free of turbidity. Field

measurements of water quality parameters such as turbidity, specific conductance, pH, and temperature will be made.

#### Bedrock Monitoring Well Construction

All well materials will be thoroughly steam-cleaned and placed on clean polyethylene sheeting prior to installation. Monitoring wells MW-10R, MW-11R, and MW-14R will be completed as an open borehole.

Monitoring well MW-8R will be constructed with 2-inch ID, 304 stainless steel threaded casing and screen with water tight joints. The well screen length will not exceed 10 feet. The depth and length of the screened interval and final well construction details will be determined in the field by the supervising geologist/engineer and USEPA oversight contractor. The well screen slot size will be 0.010 inch (No. 10 slot). Figure B3 illustrates the typical bedrock monitoring well construction details and Figure B4 illustrates the monitoring well construction details for monitoring well MW-8R.

A sand pack, comprised of clean quartz sand and chemically non-reactive, will be placed around the well screen and will extend a minimum of two feet above the well screen. The sand pack material will be such that 90% by weight is larger than the screen slot size of 0.010 inch (consistent with previous well construction). A minimum of one foot of filter pack (fine-grained sand pack) will extend above the sand pack. No more than five feet of sand and filter pack (combined) will be used above the top of the well screen and the filter pack will not extend above the 6-inch steel casing. A cement/bentonite grout (6%-10% bentonite) mixture will be pressure grouted with a tremie pipe (side discharge) from above the filter pack to ground surface. All grouting and sealing mixtures will be in accordance with the NJDEP Field Sampling Procedures Manual (May 1992). A mud balance will be used to determine the target density of the mixture and the results will be recorded on the monitoring well installation logs.

The bedrock monitoring wells will be completed as flush mount wells. A protective steel casing equipped with a locking cap will be set approximately 3 feet below ground surface. The monitoring well number will be imprinted on the well cover lid.

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The construction of monitoring well MW-8R will be in accordance with NJDEP bedrock monitoring well specifications (Field Sampling Procedures Manual - Appendix 7-1, A6) which allows for the installation of well screen and riser in the bedrock borehole. The monitoring wells will be developed in accordance with the NJDEP Field Sampling Procedures Manual (May 1992) and the USEPA Monitoring Well Development Guidelines for Superfund Project Managers (April 1992).

Monitoring well MW-8R will be developed using a combination of a surge block and submersible pump. The bedrock wells completed with open borehole will be developed using only a submersible pump. A surge block will not be used to avoid damaging the borehole. Each well will be developed until relatively free of turbidity. Field measurements of water quality parameters such as turbidity, specific conductance, pH, and temperature will be made.

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### **3.0 GEOPHYSICAL AND HYDROGEOLOGIC TESTING**

#### **3.1 Geophysical Testing**

Geophysical testing will be performed on existing on-property monitoring wells MW-2D, MW-2R, MW-5D, and MW-7D to obtain information on grout integrity. To "calibrate" the data collected from the geophysical testing of the existing wells, geophysical testing will be performed on several of the proposed off-property monitoring wells to provide a 'standard' for comparison with the data collected from the existing wells. It is anticipated that geophysics will be conducted in two proposed wells. The actual wells will be determined in the field. It is anticipated that natural gamma and acoustic (cement bonding) geophysical testing will be performed. Existing wells will also be surveyed by downhole camera to verify casing integrity.

Additional downhole geophysical testing will be performed to enhance the interpretation of hydrogeologic testing data using the following methods:

- Downhole velocity survey;
- Caliper log; and,
- Temperature log.

These methods will be applied to the pilot bedrock corehole MW-8R, where the downhole data will be correlated with rock logging and hydrogeologic test data. Downhole velocity logging will also be conducted at wells MW-5D, MW-7D, and MW-11D.

The borehole geophysical logging technical procedures are described in detail in Attachment B3.

#### **3.2 Long Term Water Level Monitoring**

Continuous groundwater level data will be collected for a period of approximately two months using electronic datalogging units and pressure transducers at the following monitoring wells: MW-2R, MW-2D, MW-5D, MW-7D, MW-8D, MW-8R, MW-10R, MW-11R, MW-12D, and MW-14R.

Continuous water level data will be collected for a period of approximately two months using a Steven's recorder-type device or electronic datalogging units and pressure transducer that will be

installed in Peach Island Creek at the approximate location SWM-1 shown on Figure B1. A stilling well will be used to protect the instrument. The construction detail will be as shown on Figure B5.

Precipitation data will be obtained from the Newark International Airport located approximately 10 miles from the Site which is monitored by the National Oceanic and Atmospheric Administration (NOAA) and National Weather Service.

### **3.3 Hydrogeologic Testing**

#### **3.3.1 Packer Testing**

Estimates of horizontal hydraulic conductivity, hydraulic head and potential groundwater flow zones will be obtained by conducting packer tests in each of the cored boreholes MW-8R, MW-10R, MW-11R, and MW-14R prior to installation of the well casing and screen, where applicable. Packer testing procedures and data analysis are described in Attachment B4.

#### **3.3.2 Variable Head Tests**

Estimates of the horizontal hydraulic conductivity will be obtained by conducting rising and falling head slug tests in monitoring wells MW-10D, MW-14D, MW-15D, MW-16D, MW-17D, and MW-18D.

The general procedure that will be used to accomplish the slug testing is as follows:

- The static water level will be recorded using an electronic water level indicator, prior to the insertion of any other equipment;
- A vibrating wire pressure transducer will be placed at a depth below the static water level;
- The pressure transducer will be connected to a datalogging device and calibrated using the known depth of the transducer and the static water level. A portable field computer will be used to monitor the test in real time;
- Once the water level within the test well has stabilized, a volume or "slug" will be introduced into the well by rapidly lowering a weighted stainless steel bailer (with the end plugged) into the well using a new length of nylon rope. The resultant water level change will be recorded;
- Upon stabilization of the water level following the falling head test, the "slug" will be withdrawn and the resulting water level rise recorded;

- 
- After completion of testing, all equipment will be decontaminated with Alconox and distilled water before proceeding to the next well.

Data from the slug tests will be analyzed using modified Hvorslev (Hvorslev, 1951) method.

7

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#### **4.0 GROUNDWATER SAMPLING**

##### **4.1 Overview**

One round of groundwater sampling is proposed for off-property monitoring wells MW-8R, MW-10D, MW-10R, MW-11R, MW-14D, MW-14R, MW-15D, MW-16D, MW-17D, and MW-18D. Each sample will be analyzed for TCL/TAL constituents. Groundwater samples for metals will not be filtered (e.g., total metals). In addition, samples will be collected in monitoring wells MW-5D, MW-7D, and MW-11D from a second zone other than the middle of the well screen where samples are typically taken based on the downhole flow velocity survey and analyzed for PCE and TCE only as "fingerprint compounds." These additional samples will be collected on a single trial basis. Groundwater sampling will not begin any sooner than two weeks after monitoring well installation and development and will be undertaken concurrently with a scheduled quarterly monitoring round. All well sampling activities will be performed according to the HASP provided in Appendix D. The type and size of each sample bottle and preservation are described in the QAPjP provided in Appendix C (Table C7). QA/QC samples will include field duplicates, trip blanks, rinsate blanks, and MS/MSD. The collection frequency of QA/QC samples is identified in the QAPjP provided in Appendix C (Table C4). General sampling considerations and documentation and procedures for handling of quality control samples, sample preservation, chain-of-custody, and sample shipping are provided in Attachment B5. During decontamination procedures and sampling, all field personnel will wear phthalate-free gloves.

##### **4.2 Groundwater Sampling Procedures**

Prior to purging the monitoring well, the casing volume will be determined by measuring the water level in the well and utilizing well construction data to calculate the casing volume of the well below the water table. A water-level meter will be used to measure the depth from the top of the well casing to the top of water surface to the nearest 0.01 feet. The water-level meter will be rinsed with distilled water prior to each measurement. The depth to the bottom of the existing wells will be measured to confirm the construction details.

For consistency with the existing O&M program, a procedure for bailers is described below. For future work associated with both the off-property investigation and subsequent quarterly O&M events, a low flow purge method is proposed, consistent with current USEPA sampling policies. A procedure for sampling using the low flow purge method is also provided below.

Groundwater Sampling Procedure - Bailer

To obtain a representative groundwater sample, the wells will be purged with a decontaminated stainless steel Grundfos Redi-Flo 2 submersible pump or equivalent. The pump and power cord will be decontaminated using Alconox (or equivalent) and distilled water prior to each use. New polyethylene tubing will be attached to the submersible pump to discharge water from the well, and will be disposed of after each use. Tubing exterior will be cleaned with Alconox (or equivalent) and rinsed with distilled water before use. Purging rates will not exceed five gallons per minute (gpm).

Field parameters, comprising pH, specific conductance, and temperature will be measured and recorded prior to purging the well and after each well volume. Sampling will not begin until at least three well volumes are purged and the last two field measurements differ by less than 10%. All reasonable efforts will be made to keep purging rates low to avoid overpumping or pumping the well to dryness. However, in some situations, evacuation of three well casing volumes may not be practicable in wells with slow recoveries. If a well has been pumped to near dryness at a rate less than 0.5 gpm, the well will be sampled within three (3) hours of evacuation or when adequate water has recharged to collect a complete sample set. All purge water will be collected in D.O.T approved 55-gallon drums, transported to the 216 Paterson Plank Road Site, and subsequently pumped to the on-site holding tank.

The following information will be recorded in the Sample Information Collection Form (Attachment B2) for each monitoring well sampled:

Before Purging:

- Date, time, and weather conditions;
- Well ID;
- PID readings taken from the well immediately after the cap is removed;
- pH, temperature, and specific conductivity (after each well volume);
- Total depth of well and water from top of inner casing; and,
- Water volume in well.

After Purging:

- Start and end time for purging;
- Purge method;
- Purge rate;
- Total volume purged; and,



After Sampling:

- Start and end time for sampling;
- Sampling method; and
- Pertinent observations regarding sample characteristics (turbidity, color, etc.).

Well sampling will be performed within two hours of purging or three hours if the well was purged to dryness. Each well will be sampled with a disposable Teflon bailer with a single check valve (bottom). Each bailer will be specially cleaned by the manufacturer (VOSS Technologies) prior to shipment and documentation of the cleaning procedure will be available. As an alternative, dedicated stainless steel bailers may be used and secured to the well cap. Each bailer will have a dedicated Teflon-coated stainless steel leader, which will be decontaminated with Alconox (or equivalent) and rinsed with distilled water. The leader will be three feet in length and will be attached to dedicated nylon rope. The bailer will then be carefully lowered until it is submerged. The first bailer recovered after well purging will be used for sample collection.

The preferred order of sample collection is as follows:

- Field measurements (temperature, pH, and specific conductance);
- Volatile organic compounds (VOCs);
- Base neutrals/acid extractables (SVOCs);
- Total metals;
- Pesticides/PCBs; and,
- Total Cyanide.

The disposable Teflon bailers are decontaminated by the manufacturer according to the following procedures:

- Washed thoroughly with Liquinox laboratory detergent;
- Rinsed with DI water;
- Rinse with 10 percent nitric acid solution;

- Rinsed thoroughly with DI water;
- Rinsed with Isopropanol; and,
- Dried in a closed room.

Dedicated stainless steel bailers will be decontaminated prior to initial use in accordance with the following procedure:

- Wash and scrub with non-phosphate detergent;
- Tap water or distilled water rinse;
- Rinse with 10 percent ultrapure grade nitric acid;
- Tap or distilled water rinse;
- A solvent rinse consisting of either:
  - A methanol rinse followed by a hexane rinse, or an isopropanol only rinse
- A demonstrated analyte-free water rinse;
- Air dry; and
- Wrap in aluminum foil prior to transport to the field.

Solvents used for cleaning will be pesticide grade or better.

If filtration of groundwater samples for dissolved metal analysis is performed, the filtration device will be decontaminated following the above procedure for dedicated bailers with the exception of rinsing with a solvent.

#### Groundwater Sampling Procedure - Low Flow

The monitoring wells will be purged and sampled with a stainless steel Grundfos Redi-Flo 2 submersible pump (or equivalent) or a dedicated bladder pump. The decontamination procedure for the submersible pump is described in Section 6.0. The low flow purge and sampling procedures are described below.

- If purging with a submersible pump, dedicated teflon lined polyethylene tubing will be used for each well. The submersible pump will be carefully lowered into the well to the center of the well screen interval.
- Each well will be purged at a rate of between approximately 200 and 1000 milliliters per minute. The water level in the well will be monitored during pumping, and ideally the pumping rate should equal the well recharge rate with little or no water level drawdown in the well (less than about 0.3 feet). There will be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record the pumping rate adjustments and depth(s) to water in the logbook.
- During purging, monitor the field parameters (temperature, pH, turbidity, specific conductance and dissolved oxygen) with a Horiba U-10 instrument (or equivalent) approximately every 5 minutes until the parameters have stabilized to within 10%, over a minimum of two consecutive readings. Readings will be taken in a clean container, rinsed with distilled water prior to each use (preferably a glass beaker), and the monitoring instrument allowed to stabilize before collection of the next sample. The Horiba instrument takes the readings consecutively and therefore the process to record all the measurements may take longer than 5 minutes. If so, measurements will be taken as often as practicable. Dissolved oxygen measurements will be taken with a flow-through cell.
- The pump flow rate will be reduced to approximately 100 milliliters per minute during collection of samples for VOCs and gas sensitive parameters and approximately 500 milliliters per minute for other parameters. Once the field parameters have stabilized, collect the samples directly from the end of tubing. Volatiles and analytes that degrade with aeration must be collected first. The bottles will be preserved and filled according to the procedures specified in the QAPjP and Attachment B5. All sample bottles will be filled by allowing the pump discharge to flow gently down the inside of the bottle with minimal turbulence. Cap each bottle as it is filled.
- The preferred order of filling of sample bottles is the same as described in the groundwater sampling procedure for bailers.
- Quality-Control samples will be used to monitor sampling and laboratory performance and will include duplicates, spikes, and blanks. Quality Control and Quality Assurance (QA/QC) procedures are described in the QAPjP and Attachment B5.

The following sample identification (ID) number scheme will be used to define the different media and different quality control samples. The samples will be assigned up to an 8-digit alpha-numeric identification number as follows:

1   2   3   4   5   6   7   8

---

The 1st digit is used to indicate type of QC sample as follows:

T	trip blank
R	rinsate blank
F	field duplicate
O	if not a QC sample

Digits 2 and 3 indicate the matrix as follows:

GW groundwater

The fourth, through eighth digits are numeric fields indicating the sample number and are assigned as follows:

- For monitoring wells this will be the well number
- For QC samples (trip blank, rinsate blank) this will be a sequentially assigned number
- For field duplicates this will be the location at which the duplicate was taken.

Examples of ID numbers are as follows:

OGWMW11R	groundwater sample from monitoring well MW-11R
FGWMW11R	field duplicate of MW-11R
TGW003	third trip blank collected for groundwater samples

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## **5.0 FIELD MEASUREMENTS**

### **5.1 Overview**

Field measurements of water levels, temperature, pH, specific conductance, dissolved oxygen, and turbidity will be completed at the time of sample collection, as appropriate.

### **5.2 Water Level Measurements**

The well identification number, measuring device type and serial number, date and time will be recorded prior to each water level measurement. The water level meter used for recording water levels will have the depth graduations checked with an independent measuring tape for calibration before field use. The water level meter will be rinsed with distilled water prior to each use.

The water level meter will be turned on and the battery checked prior to each water level measurement. The wire will be lowered into the monitoring well and stopped at the depth where the water level meter indicates a completed circuit. The depth to water will be recorded to the nearest 0.01 foot.

### **5.3 Temperature and pH Measurement**

The temperature and pH of each water sample will be measured using an automatic temperature compensating pH probe and will be taken prior to purging and after each well volume is extracted. If the low flow purge technique is used, measurements will be recorded approximately every five minutes (or as appropriate). The probe will be calibrated using buffer solutions of the appropriate range for expected values of pH according to the manufacturers directions prior to use. The meter will be recalibrated every four hours during periods of extended use according to the manufacturer's specifications. The pH will be recorded to the nearest 0.01 units and the temperature to the nearest 0.1° C or F.

### **5.4 Specific Conductivity Measurement**

The specific conductance of each water sample will be measured with a portable temperature-compensated conductivity meter and will be taken prior to purging and after each well volume is extracted. If the low flow purge technique is used, measurements will be recorded approximately

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every five minutes (or as appropriate). The instrument will be calibrated according to the manufacturers directions prior to use. The meter will also be recalibrated every four hours during periods of extended use according to the manufacturer's specifications. The specific conductance will be recorded to the nearest whole number (microsiemens/cm).

#### **5.5 Dissolved Oxygen Measurement**

If the low flow purge technique is used, dissolved oxygen measurements will be recorded approximately every five minutes (or as appropriate) with a portable meter with a flow-through cell. The instrument will be calibrated according to the manufacturers directions prior to use. The instrument will also be recalibrated every four hours during periods of extended use according to the manufacturers specifications. The dissolved oxygen will be recorded to the nearest 0.1 mg/l.

#### **5.6 Turbidity Measurement**

If the low flow purge technique is used, turbidity measurements will be recorded approximately every five minutes (or as appropriate) with a portable instrument. The instrument will be calibrated according to the manufacturers directions prior to use. The instrument will also be recalibrated every four hours during periods of extended use according to manufacturers specifications. The turbidity will be recorded to the nearest 0.1 NTU.

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## **6.0 DECONTAMINATION PROCEDURES**

### **6.1 Drill Rigs and Drilling Equipment**

Drill rigs and downhole drilling equipment used at the site will be decontaminated prior to use at the site and between boreholes. Decontamination will be conducted at the designated decontamination area at all times. The designated decontamination area will be at the location shown on Figure B1.

Decontamination will include steam cleaning and manual scrubbing, as necessary, to remove any visible contamination.

### **6.2 Sampling Equipment**

Decontamination of stainless steel split-spoon samplers will be performed at each borehole location. The decontamination procedure will include a laboratory grade non-phosphate detergent and tap water scrub to remove visual contamination followed by a generous tap water rinse. All well materials will be steamed cleaned prior to installation. After decontamination, the well materials will be placed on clean polyethylene sheeting prior to installation.

Groundwater sampling equipment used for the low flow purge technique will be decontaminated prior to use and following sampling of each well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the sample) will be decontaminated by one of the procedures listed below. Procedure 2 will be implemented at monitoring wells where positive OVA and/or PID readings, odor, or previous data indicate high contamination (e.g., greater than 1000 ppb).

#### **Procedure 1**

- Steam clean the outside of the submersible pump.
- Pump hot water from the steam cleaner through the inside of the pump.
- Pump approximately five gallons of non-phosphate detergent solution through the inside of the pump.
- Pump tap water through the inside of the pump to remove all of the detergent solution.
- Pump distilled water through the pump.

---

**Procedure 2**

- The decontaminating solutions will be either be pumped from buckets through the pump or the pump will be disassembled and flushed with the decontaminating solutions. The detergent and isopropyl alcohol used in the decontamination process will be used sparingly and water flushing steps be extended to ensure that any sediment trapped in the pump is flushed out. the outside of the pump and the electrical wires will be rinsed with the decontaminating solutions, as well. The procedure is as follows:
  - Flush the equipment/pump with potable water.
  - Flush with non-phosphate detergent solution (approximately five gallons).
  - Flush with tap water to remove all of the detergent solution.
  - Flush with distilled water.
  - Flush with isopropyl alcohol.
  - Flush with distilled water.

**6.3 Packer and Geophysical Testing Equipment**

All downhole equipment associated with the packer testing equipment and borehole geophysical logging will be decontaminated by rinsing with Alconox (or equivalent) and distilled water prior to use at each boring or well.

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**TABLE B1**  
**SUMMARY OF OFF-PROPERTY INVESTIGATION**  
**MONITORING WELL INSTALLATION, HYDROGEOLOGIC TESTING AND**  
**LONG TERM WATER LEVEL MONITORING PROGRAM**

WELL ID	LOCATION	OBJECTIVE	RATIONALE
MW-8R (deep bedrock pilot boring)	southeast of the site off-property	- groundwater level - depth to top of bedrock	To refine the geologic and hydrogeologic model and provide groundwater quality data in the bedrock unit off-property.
MW-10R	southwest of the site off-property	- continuous sampling of overburden to obtain information on lithology	
MW-11R	northwest of the site off-property	- coring of bedrock to obtain information on the lithology, fracture frequency, and degree of weathering	
MW-14R	northeast of the site & Peach Island Creek off-property	- groundwater quality data in the bedrock unit - hydraulic conductivity value through packer test analysis	
MW-10D	southwest of the site off-property	- groundwater level - depth to top of bedrock	To refine the geologic and hydrogeologic model and provide groundwater quality data in the till/weathered bedrock units off-property.
MW-14D	northeast of the site & Peach Island Creek off-property	- groundwater quality data in the till/weathered bedrock units - hydraulic conductivity value through slug test analysis	
MW-15D	northwest of the site off-property		
MW-16D	northwest of the site off-property		
MW-17D	southeast of the site off-property	- groundwater level in the till - hydraulic conductivity value through slug test analysis - groundwater quality in the till unit	To determine vertical hydraulic gradient and provide groundwater quality data in the till and weathered bedrock units.
MW-18D	southeast of the site off-property	- groundwater level in the weathered bedrock - hydraulic conductivity value through slug test analysis - groundwater quality in the weathered bedrock unit	
MW-2R, MW-2D, MW-5D, MW-7D MW-8D, MW-8R, MW-10R, MW-11R, MW-12D, & MW-14R SWM-1	on-site, off-property & Peach Island Creek	- long term water level monitoring	To evaluate if potential groundwater pumping effects on water levels in the till and bedrock.  To evaluate if tidal fluctuations in the Peach Island Creek influence groundwater elevations.

## Notes:

1. Refer to Figure B1 for proposed locations.



"MEADOWLANDS SPORTS COMPLEX"

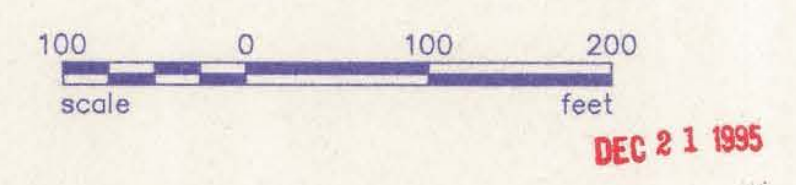



### LEGEND

- SITE BOUNDARY
- PROPERTY/RIGHT-OF-WAY BOUNDARIES
- CONTOUR LINE
- STREAM
- FENCE
- UTILITY POLE
- MW-8D EXISTING MONITORING WELL
- MW-10D PROPOSED MONITORING WELL
- △ PROPOSED SURFACE WATER MONITORING LOCATION
- ▨ SLURRY WALL ALIGNMENT
- SHEET PILE WALL ALIGNMENT

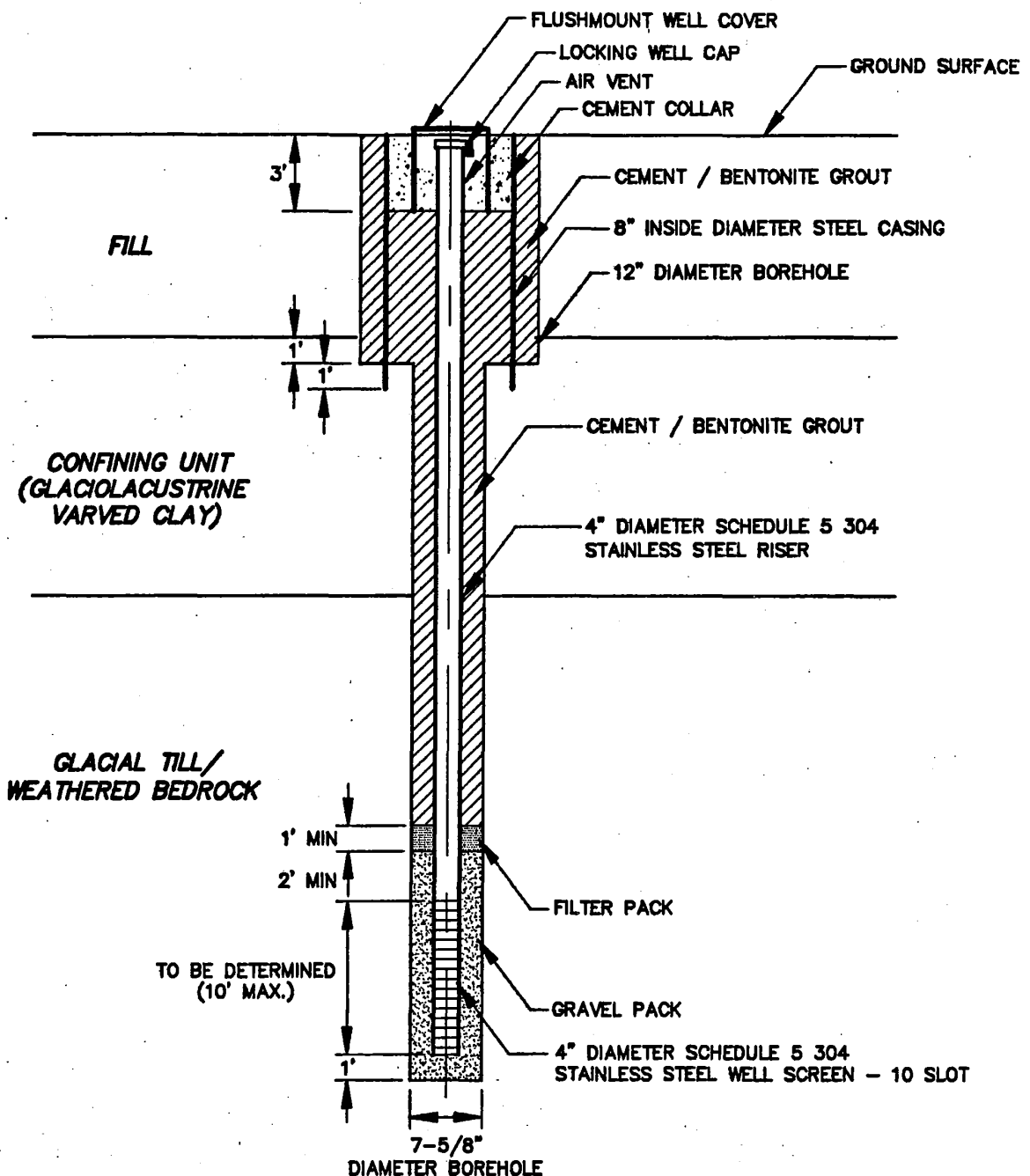
### REFERENCE

- 1.) TOPOGRAPHIC DATA AND SURFACE FEATURES BASED ON INFORMATION BY TAYLOR, WISEMAN & TAYLOR CONSULTING ENGINEERS/SURVEYORS/PLANNERS/LANDSCAPE ARCHITECTS, MOUNT LAUREL, NEW JERSEY, DATED 06/12/92, SCALE 1"=40'.
- 2.) LOT AND BLOCK DATA FROM LOCAL TAX MAP, BOUNDARIES APPROXIMATE.
- 3.) RMW-13D WAS INSTALLED IN OCTOBER 1995. THE LOCATION SHOWN IS APPROXIMATE.



REV	DATE	DESCRIPTION	DR BY	CHK BY	RVW BY
PROJECT:	216 PATERSON PLANK ROAD NPL SITE CARLSTADT, NEW JERSEY				
SHEET TITLE:	PROPOSED OFF-PROPERTY INVESTIGATION LOCATIONS				
 Golder Associates Mt. Laurel, New Jersey		PROJECT No.	943-6222	FILE No.:	NJ03-355
		CLIENT PROJ. No.		DRAFTING SUBTITLE:	03
		DES BY	PSF 09/26/95	SCALE:	AS SHOWN
		DR BY	JSG 12/21/95		
		CHK BY			
		RVW BY			
FIGURE B1					





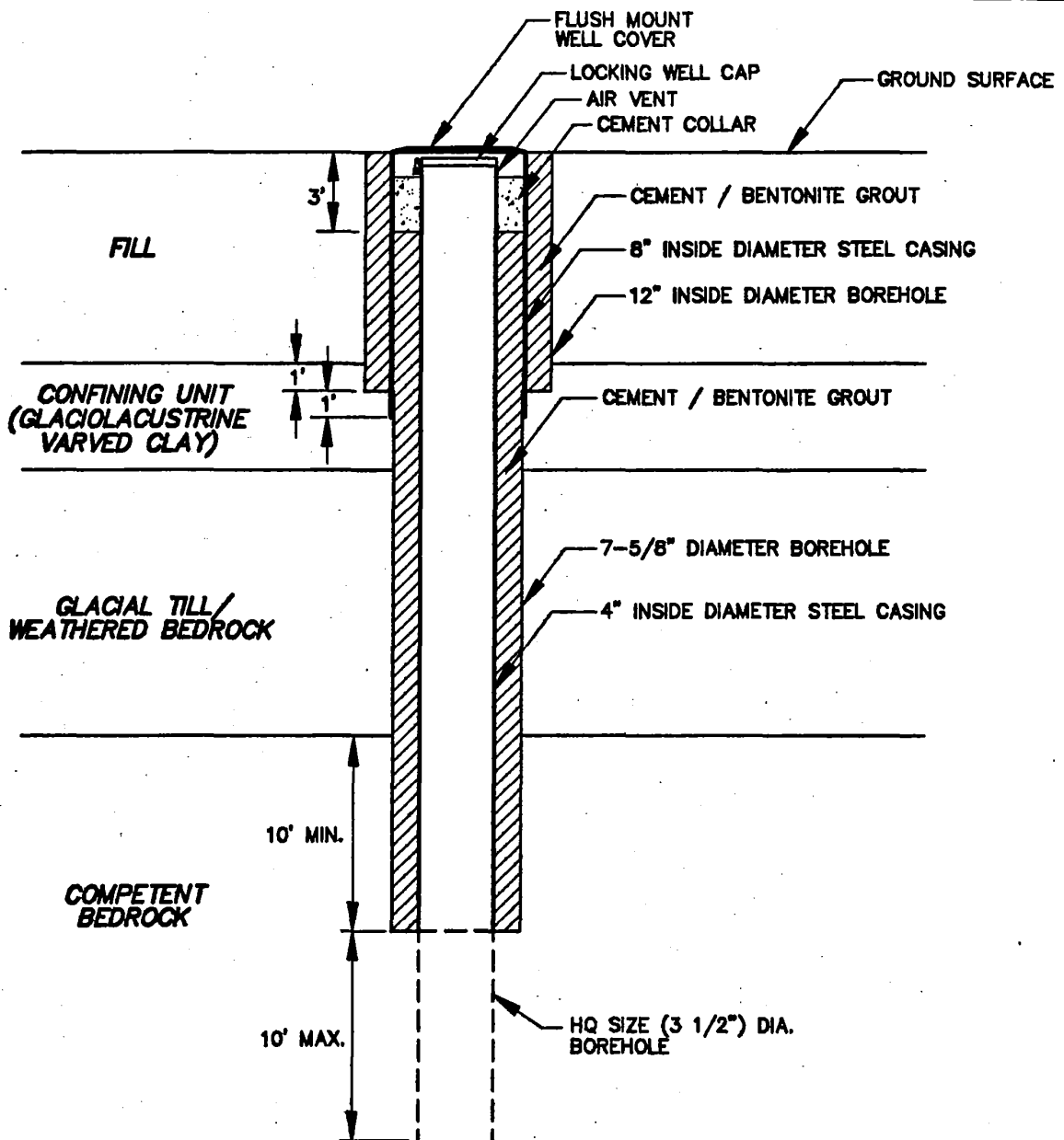
## NOTES

- 1.) BOREHOLE TO EXTEND A MINIMUM OF 1 FOOT INTO CONFINING LAYER. OUTER CASING TO BE DRIVEN A MINIMUM OF ONE FOOT BELOW THE DRILLED BOREHOLE.
- 2.) MONITORING WELLS MW-17D AND MW-18D WILL BE COMPLETED SOLELY IN THE TILL AND WEATHERED BEDROCK, RESPECTIVELY.

DEC 21 1995

JOB No.: 943-6222	SCALE: NOT TO SCALE	<b>TYPICAL TILL/WEATHERED BEDROCK MONITORING WELL CONSTRUCTION DETAIL</b>
DR BY: JSG	DATE: 12/21/95	
CHK BY: SGM	FILE No.: 1NJ03-256	
REV BY: <i>[Signature]</i>	DR SUBTITLE: 03	
<b>Golder Associates</b>		216 PATERSON PLANK ROAD SITE
		FIGURE <b>B2</b>

R2-0000110

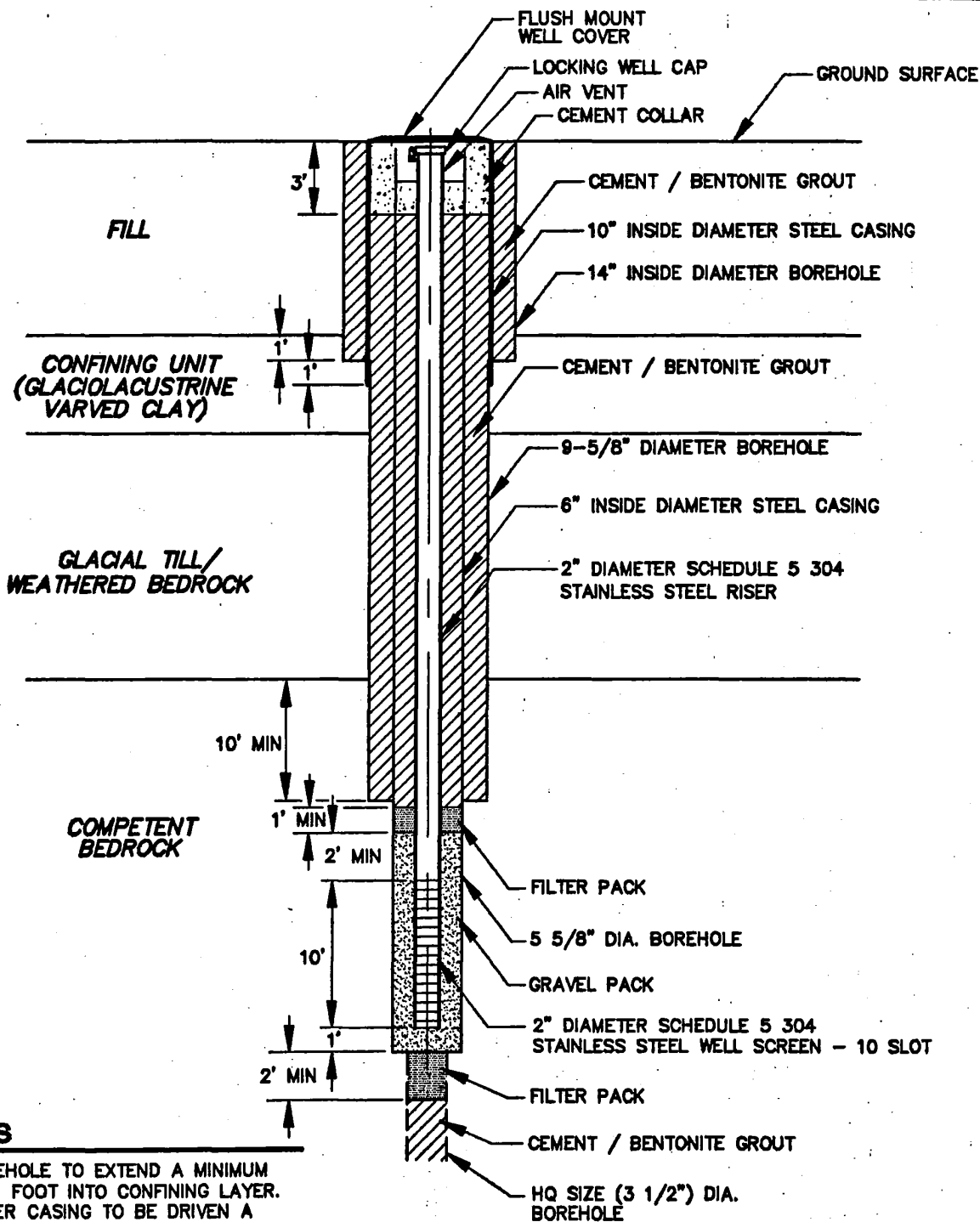


## NOTES

- 1.) BOREHOLE TO EXTEND A MINIMUM OF 1 FOOT INTO CONFINING LAYER. OUTER CASING TO BE DRIVEN A MINIMUM OF ONE FOOT BELOW THE DRILLED BOREHOLE.
- 2.) 4" STEEL CASING TO BE DRILLED 10 FEET INTO COMPETENT BEDROCK.

DEC 21 1995

JOB No.: 943-8222	SCALE: NOT TO SCALE	<b>TYPICAL BEDROCK MONITORING WELL CONSTRUCTION DETAIL</b>
DR BY: JSG	DATE: 12/21/95	
CHK BY: <i>SDM</i>	FILE No.: 1NJ03-257	
REV BY: <i>[Signature]</i>	DR SUBTITLE: 03	
<b>Golder Associates</b>		216 PATERSON PLANK ROAD SITE <small>FIGURE</small> <b>B3</b>



## NOTES

- 1.) BOREHOLE TO EXTEND A MINIMUM OF 1 FOOT INTO CONFINING LAYER. OUTER CASING TO BE DRIVEN A MINIMUM OF ONE FOOT BELOW THE DRILLED BOREHOLE.
- 2.) 6" STEEL CASING TO BE DRILLED 10 FEET INTO COMPETENT BEDROCK.

DEC 21 1995

JOB No.:	943-6222	SCALE:	NOT TO SCALE
DR BY:	JSG	DATE:	12/21/95
CHK BY:	SDm	FILE No.:	NJ03-353
REV BY:	<i>[Signature]</i>	DR SUBTITLE:	03

## BEDROCK MONITORING WELL MW-8R CONSTRUCTION DETAIL

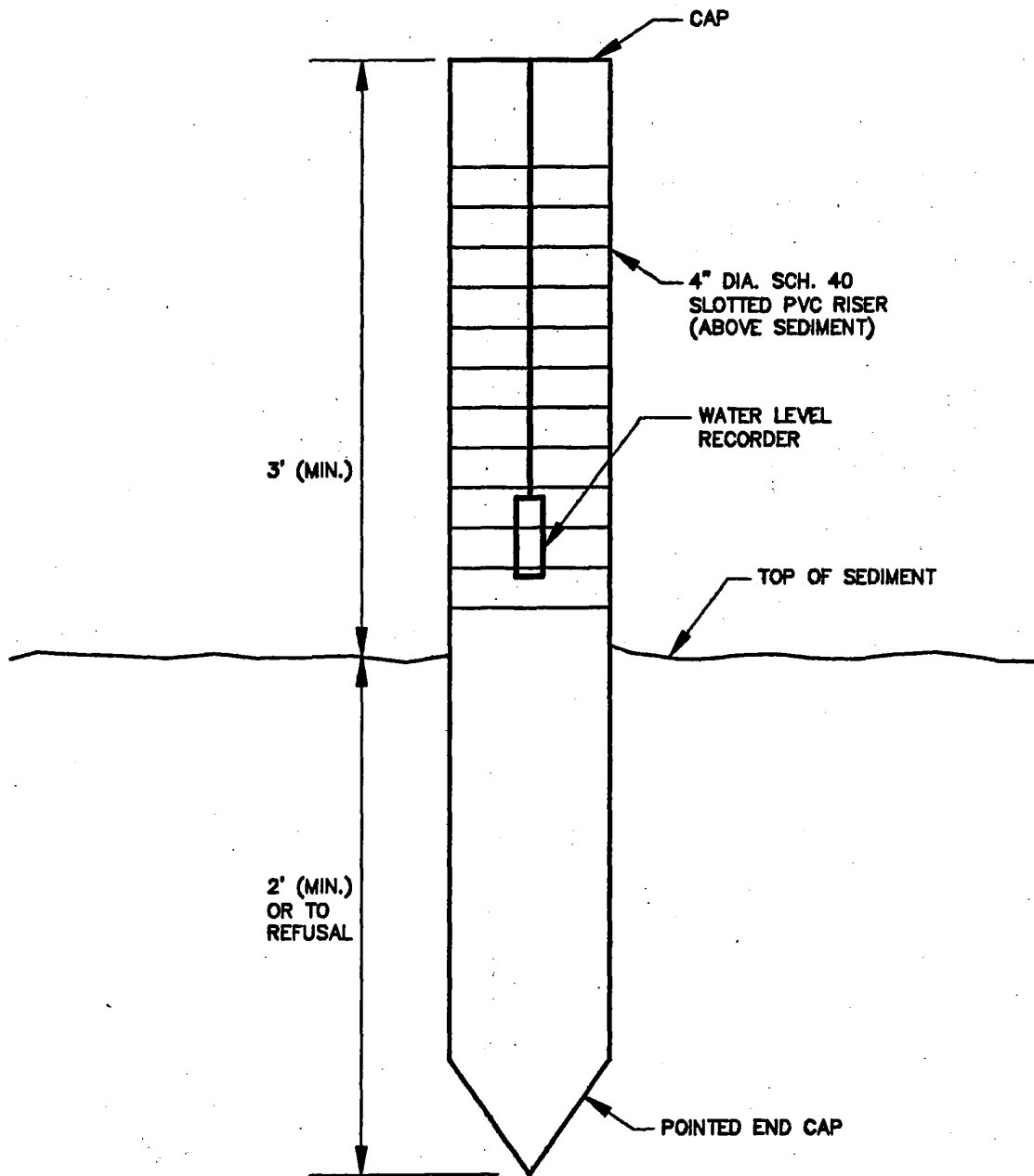
**Golder Associates**

216 PATERSON PLANK ROAD SITE

FIGURE

**B4**

R2-0000112



# NOTES

- 1.) PVC PIPE WILL BE PUSHED AT LEAST 2 FEET INTO THE SEDIMENT OR TO REFUSAL AND, IF POSSIBLE, SECURED TO THE CULVERT UNDERLYING GOTHAM PARKWAY.

DEC 21 1995

JOB No.: 943-6222	SCALE: NOT TO SCALE	<b>TYPICAL STILLING WELL CONSTRUCTION DETAIL</b>	
DR BY: JSG	DATE: 12/21/95		
CHK BY: SDM	FILE No.: NJ03-354		
REV BY: <i>[Signature]</i>	DR SUBTITLE: 03		
<b>Golder Associates</b>		216 PATERSON PLANK ROAD SITE	FIGURE <b>B5</b>



**Attachment B1**  
**Soil/Rock and Well Installation Logs**

PROJECT: SCP CARLSTADT

PROJECT LOCATION: CARLSTADT, NEW JERSEY

PROJECT NUMBER: 943-6222

## RECORD OF BOREHOLE RMW-13D

BORING START: 10-20-95

BORING LOCATION:

SHEET: 1 OF 2

DATUM:



DEPTH & FEET	BORING METHOD	SOIL PROFILE			SAMPLES					REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV	NUMBER	TYPE	BLOWS / 6 in	N			REC/ATT
					DEPTH							
0	12" DIA. HSA 7 7/8" ROT.	0.0-4.0 ft. Very dense, reddish-brown, fine SAND, some silt grading to a loose, brown silt, trace sand with small pieces of red brick material. (FILL)	FILL		0.00	B-1	SS	0,24,29,22	53	6/18	First 6" was asphalt. PID - 3.0 ppm	
B-2					SS	6,5,5,6	10	6/24	PID - 2.3 ppm			
5		4.0-10.9 ft. Firm to very stiff, brown-gray SILT, some sand, trace fine to coarse gravel, trace organics grading to a brown-gray SILTY CLAY, trace fine sand, trace organics.	CL		4.00	B-3	SS	6,6,6,6	14	4/24	PID - 2.6 ppm	
					B-4	SS	6,6,6,13	16	4/24	PID - 1.7 ppm		
					B-5	SS	2,2,3,3	5	11/24	PID - 2.6 ppm		
10		10.9-14.0 ft. Stiff to very stiff, gray to light brown rhythmically bedded units grading from SILT to CLAY (~1/4 inch thick).	CL		10.90	B-6	SS	5,5,9,3	14	16/24	PID - 70 ppm	
					B-7	SS	10,9,6,7	17	10/24	PID - 11.5 ppm		
15		14.0-21.0 ft. Very soft to soft, purple-brown, massive CLAY.	CH		14.00	B-8	SS	2,1,3,2	4	24/24	PID - 35 ppm	
					B-9	SS	1,1,1,1	2	24/24	PID - 1.5 ppm		
					B-10	SS	2,1,2,2	3	24/24	PID - 2.0 ppm		
20		21.0-25.0 ft. Very soft to soft, purple-brown CLAY, trace to little coarse sand, little fine gravel (pieces of red siltstone and green mudstone).	CH		21.00	B-11	SS	1,1,1,1	2	24/24		
					B-12	SS	0,2,2,2	4	13/24	PID - 0.2 ppm		
25		25.0-29.0 ft. Firm, reddish-brown, SILTY CLAY, trace coarse sand with some pieces of reddish-brown siltstone up to 1/2 inch in diameter.	CL		25.00	B-13	SS	2,2,3,3	5	23/24	PID - 0.2 ppm	
					B-14	SS	3,3,3,3	6	10/24	PID - 0.0 ppm		
30		29.0-39.0 ft. Hard, reddish-brown, CLAYEY SILT and coarse SAND, and fine GRAVEL consisting of red siltstone, quartz, green mudstone and metamorphics (diabase?). (FILL)	GM		29.00	B-15	SS	12,27,60,66	67	22/24	PID - 0.0 ppm	
					B-16	SS	70,110,110	220	10/16	PID - 0.0 ppm		
					B-17	SS	53,53,47,56	100	24/24	PID - 0.0 ppm		
					B-18	SS	42,200/2.5'	>200	6/5.5	PID - 0.0 ppm		
35		39.0-43.5 ft. Hard, reddish-brown, interlayered CLAYEY SILT and rock fragments (reddish-brown siltstone). (Weathered bedrock)			36.00	B-19	SS	59,73,133,150/5	206	10/24		
					40.00	B-20	SS	77,100/3.5'	>100	6/5.5	PID - 0.0 ppm	

DRILL RIG: H.S.A. & WASH-WATER ROTARY  
 DRILLING CONTRACTOR: AQUIFER DRILLING  
 DRILLER: T. BROWN

Golder Associates

LOGGED: S. MITCHELL  
 CHECKED:  
 DATE: 11-20-95

R2-0000115

PROJECT: SCP CARLSTADT

## RECORD OF BOREHOLE RMW-13D

SHEET: 2 OF 2

PROJECT LOCATION: CARLSTADT, NEW JERSEY

BORING START: 10-20-95

DATUM:

PROJECT NUMBER: 943-6222

BORING LOCATION:



DEPTH IN FEET	BORING METHOD	SOIL PROFILE			SAMPLES					REMARKS	PIEZOMETER OR STANDPIPE INSTALLATION	
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV DEPTH	NUMBER	TYPE	BLOWS / 6 in	N			REC/ATT
40	HSA / ROT.	39.0-43.5 ft. Hard, reddish-brown, interlayered CLAYEY SILT and rock fragments (reddish-brown siltstone). (Weathered bedrock)			40.00	S-21	SS	90,200/1"	>200	4/7		
45		BORING TERMINATED AT 43.5 FT. BELOW GROUND SURFACE.			43.50	S-22	SS	100/3"	N/A	1/3		
45												
50												
55												
60												
65												
70												
75												
80												

Notes:  
1.) Surface casing was driven to 16.0 ft. below ground surface. The bottom cap was drilled out and the borehole advanced to 17.0 ft. Split spoon sampling resumed at 17.0 ft.  
2.) Beginning at 31.0 ft., problems were encountered with pieces of rock larger than the split spoon. As such, the borehole was advanced through these areas which precluded sampling portions of the subsurface material.

DRILL RIG: H.S.A. & WASHWATER ROTARY  
DRILLING CONTRACTOR: AQUIFER DRILLING  
DRILLER: T. BROWN

LOGGED: S. MITCHELL  
CHECKED:  
DATE: 11-20-95

Golder Associates

R2-0000116

# RECORD OF DRILLHOLE ROCK LOG

Sheet 1 of 1

PROJECT:  
PROJECT NO:  
LOCATION:

BORING METHOD:  
DRILLING DATE:  
DRILL RIG:

DATUM:  
COORDINATES N:  
AZMUTH: 000

REFERENCE ELEV:  
E:  
INCLINATION: -90

DEPTH (FEET)	ROCK TYPE			LEGEND										HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	DESCRIPTION	GRAPHIC LOG	ELEV DEPTH (FT)	B-Bedding		CL-Clayey		FR-Fracture		LI-Limonite		SM-Smooth			
				BR-Broken	CO-Contact	CO-Contact	G-Ground	MN-Manganese	SP-Stepped						
				C-Curved	F-Fresh	H-irregular	PL-Planar	ST-Stepped							
CA-Calcite		FA-Fault	J-Joint	QTZ-Quartz	UE-Uneven	R-Rough		W-Wavy							
CH-Chlorite		FE-Iron	K-Skeletal												
				DISCONTINUITY DATA											
				RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP Wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG					
				00	00	00	00	00	00						
0	Lithologic description.		0.00												
5															
10															
15															
20															
25															
30															
35															
40															

DEPTH SCALE:  
DRILLING CONTRACTOR:  
DRILLER:

LOGGED:  
CHECKED:  
DATE:



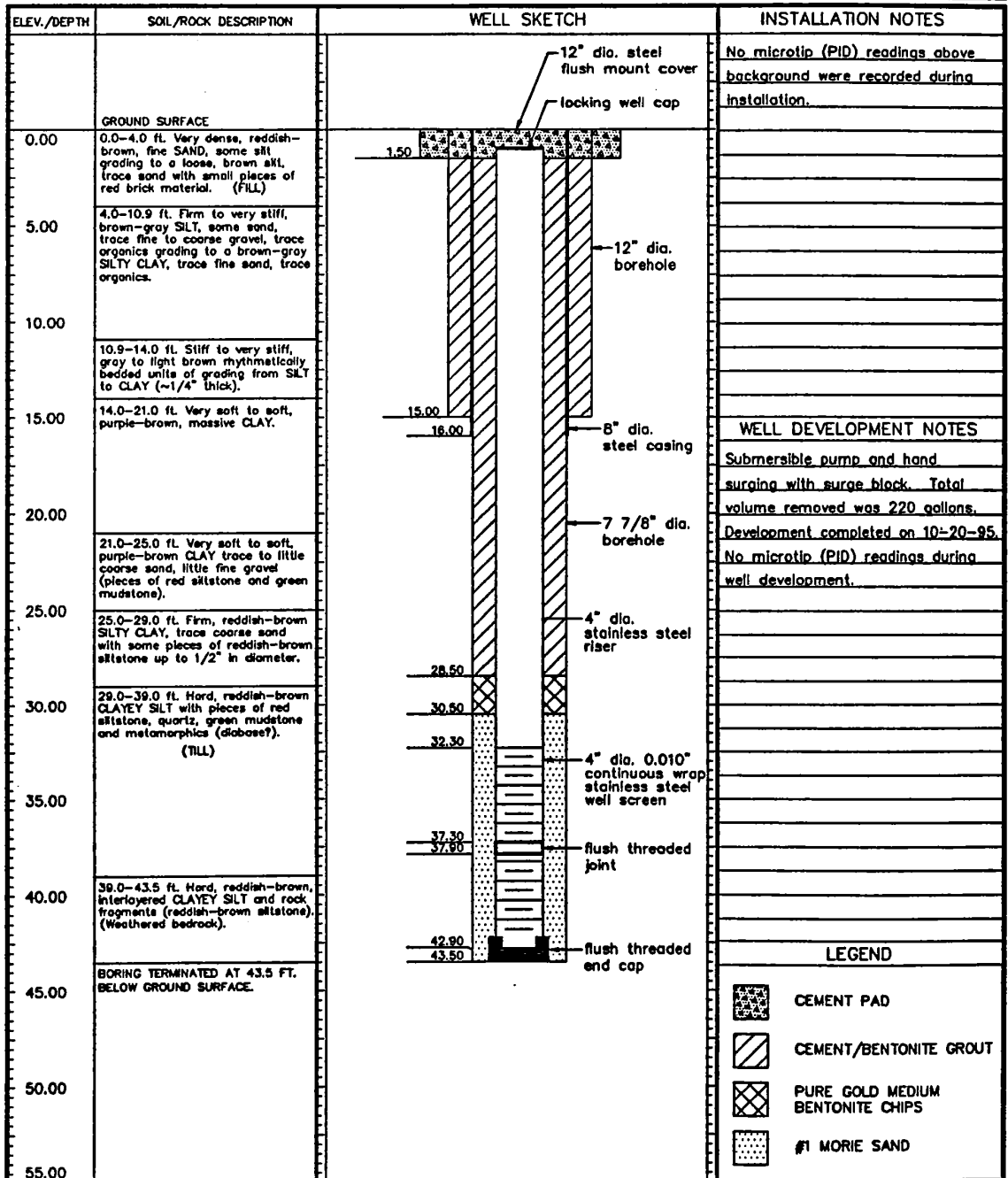
R2-0000117

# MONITORING WELL INSTALLATION LOG

JOB NO. 943-6222	PROJECT SCP CARLSTADT	WELL NO. RMW-13D	SHEET 1 of 1
GA INSP. S. MITCHELL	DRILLING METHOD 12" OD HOLLOW STEM AUGER/ 7 7/8" WASHWATER ROTARY	GROUND ELEV. _____	WATER DEPTH 6.1' BGS
WEATHER PARTLY SUNNY	DRILLING COMPANY AQUIFER DRILLING AND TESTING INC.	COLLAR ELEV. _____	DATE/TIME 0840/10-20-95
TEMP. 60° F	DRILL RIG CANTERRA CT 250	DRILLER T. BROWN	STARTED 1155/10-18-95 COMPLETED 1220/10-20-95
LOCATION / COORDINATES _____			

WELL CASING 4 in. dia. 33.5	L.I. WELL SCREEN 4 in. dia. 10.0	L.I. BENTONITE SEAL PURE GOLD MEDIUM BENTONITE CHIPS
CASING TYPE 304 STAINLESS STEEL	SCREEN TYPE 304 CONTINUOUS WRAP STAINLESS STEEL	INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED	SLOT SIZE 0.010" MACHINE SLOTTED	FILTER PACK QTY. (3.5) 100 LB BAGS
GROUT QUANTITY 40 GALLONS	CENTRALIZERS NONE USED	FILTER PACK TYPE #1 MORIE SAND
GROUT TYPE CEMENT/BENTONITE	DRILLING MUD TYPE N/A	INSTALLATION METHOD GRAVITY



Golder Associates

R2-0000118

**Attachment B2**

**Field Forms**



# FIELD REPORT

**Job No.** \_\_\_\_\_

Date \_\_\_\_\_ Time In \_\_\_\_\_ Time Out \_\_\_\_\_

---

**Weather** \_\_\_\_\_

Location \_\_\_\_\_

**Present At Site** \_\_\_\_\_

**Client** \_\_\_\_\_

---

**Owner** \_\_\_\_\_

\_\_\_\_\_

Contractor

**Signed:** \_\_\_\_\_



## Golder Associates

**CONSULTING ENGINEERS**  
**305 FELLOWSHIP RD., SUITE 200**  
**MT. LAUREL, N.J. 08054**  
**(609) 273-1110**

**To:** \_\_\_\_\_

No. \_\_\_\_\_



## SAMPLE COLLECTION INFORMATION FORM

GAI PROJECT NAME \_\_\_\_\_

GAI PROJECT NO. \_\_\_\_\_

SAMPLE ID. \_\_\_\_\_

SOURCE CODES: RIVER OR STREAM, WELL, SOIL, OTHER (CIRCLE ONE)

### PURGING INFORMATION (IF APPLICABLE)

PURGE DATE (yy/mm/dd) _____	TIME (24 HR CLOCK) _____	ELAPSED HRS. _____
CASING VOL.(Gal.) _____	GAL PURGED (Gal.) _____	
PURGING DEVICE (SEE BELOW) _____	PURGING DEVICE MATERIAL _____	DEDICATED (Y/N) _____

### SAMPLE COLLECTION INFORMATION

SAMPLING DATE (yy/mm/dd) _____	TIME (24 HR CLOCK) _____	MATRIX _____
SAMPLING DEVICE (SEE BELOW) _____	DEDICATED-(Y/N) _____	FILTERED (Y/N) _____
SAMPLING DEVICE MATERIAL _____	SAMPLE TYPE - GRAB/COMPOSITE (CIRCLE ONE)	

(A) AIR-LIFT PUMP (B) BLADDER PUMP (C) PERISTALTIC PUMP (D) SCOOP/SHOVEL (E) BAILER (F) OTHER (SPECIFY)

### WELL INFORMATION (IF APPLICABLE)

REFERENCE POINT _____	LAND ELEVATION (FT./MSL) _____
REF. PT. ELEV.(FT. MSL) _____	WELL DEPTH (FT.) _____
TO WATER (REF. PT.) _____	STICKUP (FT.) _____
ELEV.(FT. MSL) _____	WELL DIAMETER (INCHES) _____

### FIELD MEASUREMENTS (FOUR REPLICATES)

pH (STD)	_____	_____	_____	_____
SPEC. COND.(UMHOS/CM)	_____	_____	_____	_____
TEMPERATURE (C)	_____	_____	_____	_____
OTHER (SPECIFY)	_____	_____	_____	_____

### COMMENTS/CALCULATIONS

WEATHER CONDITIONS \_\_\_\_\_

SAMPLE APPEARANCE \_\_\_\_\_

2" DIA. CASING CONTAINS .163 Gal./Fl.

4" DIA. CASING CONTAINS .652 Gal./Fl.

INCLUDE SAMPLE BOTTLE SIZE, BOTTLE COLOR, BOTTLE MATERIAL, PRESERVATIVES AND ANALYTICAL METHODS ON LABORATORY CUSTODY FORMS.

SAMPLER SIGNATURE \_\_\_\_\_

DATE \_\_\_\_\_

R2-0000121

**GOLDER ASSOCIATES INC.**

**FIELD CHANGE REQUEST FORM**

**REQUESTED CHANGE:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**DATE:** \_\_\_\_\_ **REQUESTED BY:** \_\_\_\_\_

**PREVIOUS PROCEDURE REFERENCE:** \_\_\_\_\_

**PROJECT MANAGER CONTACTED:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

**FIELD CHANGE REQUEST FORM SENT:** \_\_\_\_\_ **DATE:** \_\_\_\_\_

**APPROVAL DATE:** \_\_\_\_\_

**PROJECT MANGER:** \_\_\_\_\_  
(Signature)

**APPROVAL FROM** **EPA:** \_\_\_\_\_ **NA** \_\_\_\_\_ **YES**

**CC: QA Officer**  
**Sampling Team Leader**  
**Project Files**

**Attachment B3**

**Downhole Geophysical Logging Technical Procedures**

## 1. PURPOSE

This technical procedure (TP) establishes a uniform methodology for geophysical logging of boreholes and wells using MGX instrumentation, acoustic and video methods.

## 2. APPLICATION

This technical procedure is applicable to all logging using the MGX instrumentation with applicable sondes, acoustic, and video methods.

## 3. DEFINITIONS

3.1 Sonde A Sonde is the "probe" or "tool" with sensors that is placed in the hole.

3.2 Hole As used in this procedure, a hole is a monitoring well, water supply well, or boring.

3.3 Open Hole As used in this procedure, an open hole is an uncased hole.

3.4 Logging Run A logging run is the lowering or raising of the Sonde in the hole and recording data during the motion.

## 4. REFERENCES

Colog, Inc., Instruction Manual for MGX Portable Logger  
Colog, Inc., Course Notes for Geophysical Logging  
Telford, W.M., Geldorf, L.P., Sheriff, R.C., and Keys, D.A., 1976  
Applied Geophysics Cambridge University Press, Cambridge, England

## 5. DISCUSSION

Downhole geophysical logging is used to determine physical characteristics of existing holes (diameter, casing depth, screened interval, condition of casing, condition of grouting material); determine lithology adjacent to the hole; obtain physical properties of lithologic units (moisture content, porosity, permeability, seismic velocities, mineralogy); obtain information regarding water (water quality, flow rates and directions); and other specialized uses. The MGX system consists of an electric winch, 650 ft. of single conductor cable, a portable computer (286 or better) and printer, and interchangeable logging sondes. This technical procedure will discuss the most-often used sondes which include:

- Natural gamma, self-potential and single point resistance (NG,SP,R)
- EM-39 Induction (EM)
- 3-arm caliper (CALP)
- Temperature and fluid resistivity (TEMP. FL RES)

This technical procedure also discusses video and acoustic methods, which are not used with the MGX system.

A brief summary of the method follows:

- |     |             |   |
|-----|-------------|---|
| 5.1 | <u>NG</u>   | Natural gamma measures naturally occurring radiation, usually from Potassium-40 which is often found in clays and shales. Thorium and uranium are less common sources found in subsurface materials. NG is a good lithologic indicator and can work in open, steel-cased or PVC-cased holes.  |
| 5.2 | <u>SP</u>   | Self potential measures naturally occurring voltages that occur at the boundaries of lithologic units and is a good lithologic indicator. Requires an open hole.  |
| 5.3 | <u>R</u>    | Single point resistance measures the resistance between the mud plug (ground) at the surface and the sonde. The values are primarily affected by changes in subsurface electrical properties near the sonde and is a good lithologic and moisture indicator. Requires an open hole.   |
| 5.4 | <u>EM</u>   | Uses electromagnetic induction to evaluate electrical properties of the subsurface. Depth of investigation is approximately 18 inches, and is not affected by near-hole changes (such as hole diameter). Is a good lithologic indicator for determining moisture content and water quality. Can be used in open holes or PVC cased holes. |
| 5.5 | <u>CALP</u> | Physically measures the hole diameter using 3 spring-loaded arms. Good for locating zones of weakness, fractures, screened intervals, and casing diameter. Can be used in open or cased holes.  |
| 5.6 | <u>TEMP</u> | Measures the temperature of the borehole fluid. Changes in temperature indicate water flow from fractures or permeable zones. Can be used in cased holes, but usually in open holes.  |



- 5.7 FLRS Measures the electrical properties of the borehole fluid. Changes may indicate water flow or changes in water quality. Can be used in PVC cased holes, but usually in open holes.
- 5.8 VIDEO Records video images in clear fluid-filled or dry holes. Borehole video logging is suitable for lithologic and rock structure analysis in open holes. Also useful for casing evaluations and locating debris in wells.
- 5.9 ACOUSTIC The Full Waveform Sonic log uses acoustic signals to obtain information about the borehole wall and the geology within a few inches of the borehole surface. The method has many uses including analysis of the lithology and certain physical properties (e.g. elastic moduli, permeability, porosity). Also useful for fracture detection, well completion and casing evaluation.

## 6. RESPONSIBILITY

All Field Engineers engaged in conducting downhole logging are responsible for compliance with this procedure.

## 7. EQUIPMENT AND MATERIALS

MGX winch and sonde electronics  
Tripod  
Applicable sonde  
MGX power cable, MGX to computer interface cable  
Mud plug (for SP and R logging)  
Portable computer (PC) (286 or better)  
Portable field printer  
12-volt marine battery  
Multi-outlet  
DC to AC inverter  
Extension cord  
Electrical tape  
DOW Compound 4  
Lubriplate #104 grease  
Water level tape  
Small tape measure (marked at tenths of feet)  
Distilled water

Alconox soap  
Two 5-gallon buckets  
Sprayer  
Brush, sponges  
Field book, or logging forms (Exhibit A & B)  
MGX manual and Logshell manual  
Logshell software.  
VCR & TV (Video only)  
Blank video tapes  
Microphone  
Acoustic logging equipment

## 8. PROCEDURE

### 8.1 Survey design

Determine the type of hole to be logged (open, steel or PVC cased). Generally, for geologic information, only natural gamma (NG) logs are useful in steel-cased holes, and NG and electromagnetic (EM) logs are appropriate for PVC-cased holes. Caliper and nuclear tools can be used in cased holes for casing information. All logs can be obtained in open holes. The condition of open holes will depend on the stratigraphy, drilling method and size of the hole. Additional care is required because collapsing or tight holes can grab the tool. The stability of the borehole must be verified prior to logging. Logging of questionable holes is at the discretion of the Project Manager.

Determine the geologic/hole property to be examined. Obtain hole information from drilling logs such as depth to bottom of casing, bottom of hole (BOH), and water; drilled diameter, casing diameter, and date drilled. Obtain keys for locked holes.

### 8.2 Field Set-Up

Upon arrival at the hole, park the vehicle so that the MGX is 15-20 feet from the hole. Park so that the computer and computer screen are in the shade if possible.

Measure the following upon arrival and record on logging forms:

- Reference depth (RD), usually ground surface. At completed wells use the top of the concrete pad, but measure the height of the pad.

- Top of Casing (TOC): Measure top of casing above reference depth. At completed wells measure both the inner casing and the outer protective casing. Measure at the north side of the casing.
- Water level: Reference to RD.
- In holes of questionable quality, a dummy probe (similar in size to the applicable sonde) should be lowered to the bottom of the hole to help determine the condition of the hole. However, this will disturb the temperature data. Downhole video can also be done to assess hole conditions.

### 8.3 Equipment Set-Up and Calibration Tests

#### 8.3.1 MGX System

Set-up the tripod over the hole. Make sure that the tripod is stable and that the pulley is in the direction of the MGX. Set-up the MGX winch, computer and printer in the vehicle or on the ground. Keep the cables organized. Turn on the MGX and pull out 10-20 feet of cable.

Hold the cable and apply tension to avoid tangling.

Perform cable checks in accordance with the MGX Manual. The center pin on the cable head should be insulated from the cable armor by at least 20 megaohms resistance. Continuity should be approximately  $18.4 \pm 2$  ohms for 650 feet of cable.

Connect the sonde to the cable head. Make sure all connections are clean and have a thin film of silicone on the o-ring. Turn the sonde, not the cable when connecting. A small amount of electrical tape at the joint is helpful.

If the sonde is dirty (it shouldn't be), clean it prior to logging the hole. Perform calibrations on the sonde. Calibrations vary from sonde to sonde; see the MGX Manual.

#### 8.3.2 Borehole Video

Set up the VCR and TV. Attach microphone to the VCR unit if audio description of the video log is desired. Connect power jacks for the downhole camera to the battery and plug in the video cable to the TV. Be careful with the camera and do not scratch the lens. The depth of the camera

can be measured by marking distance intervals directly on the camera cable or attaching a measuring tape to the cable.

Turn on all systems and check that the camera and recording units are functioning. No calibration is required for this method.

### 8.3.3 Acoustic Method (Full Waveform Sonic)

Follow all setup, testing, and calibration procedures as described in the equipment manual.

## 8.4 Logging Procedure

### 8.4.1 MGX Instrumentation

Place the sonde in the hole with the cable over the pulley. If the hole is muddy, use the foam ball over the cable when coming up-hole.

Using winch controls, place the top of the sonde (at cable head to sonde joint) at the top of the casing.

Turn on the PC and printer. Type "LOGSHELL" to access the logshell program. If, during logshell, certain commands don't work, the paths and/or shells may not be configured. To correct this (until you turn off the PC) type:

```
c:\Path = c:\Plot  
c:\Path = c:\ACQ  
C:\Metashe/I
```

Then type logshell. Set up the project directory, file name for the logging run, the depths, logging sondes, and printers. When you select a sonde, logshell gives you the operating instructions for the sonde. The depth reference for the sonde is given from the top of the sonde (which is at the bottom of the spring). Enter a starting depth below the RD (such as ground surface), e.g., the NG reading is at 3.5 feet below the top of the sonde. If the TOC is 2.0 feet above ground level, then the starting depth is 3.5-2.0 feet=1.5 feet below ground surface (see pg. 21, MGX Manual). Use positive numbers when below the ground surface. Use the protective casing (if present) as the TOC so you can easily see the top of the sonde.

After setting up the files, sonde procedures and starting depths, you are ready to log. Highlight "log" on the logging menu and press enter.

Set up your scales based on prior logging information, or take an educated guess. All data is recorded digitally so scales can be changed during a logging run, but final output can be produced at an optimum scale. Once scales are set, press:

F6: Turn data file on to store data

F9: Start new screen plot

F7: Turn on printer

Alt X: When done with logging run, automatically saves data file  
and returns to main menu

Note: F10 toggles between screen plot and scales status screen

F1: "Help"

At the first few holes and the last hole (minimum), log data going down-hole and up-hole to determine optimum scales and as a quality control on the data. The sondes should be run at the following speeds:

NG: 12-15 ft/min

SP&R: 15-20 ft/min

EM: 15-20 ft/min

CALP: 10-15 ft/min

Temp and FL RES: 6-8 ft/min

If using a temperature sonde, record data going down-hole in undisturbed fluids. Record FL RES data coming up-hole.

On the Logging Form (Exhibit A or B), record the direction of the log, the depth at the bottom of the hole, and the depth upon returning to the top of the hole. The starting and ending depths at the top of the hole should be within 0.5 feet for a 200-foot hole.

#### 8.4.2 Borehole Video

Lower the camera slowly into the hole by hand. Record video and field notes as required for the specific task.

#### 8.4.3 Acoustic Method (Full Waveform Sonic)

Follow all logging procedures as described in the equipment manual.

### 8.5 Demobilization From Hole

If decontamination is required, the cable (exposed to fluids) and sonde must be washed and rinsed according to decontamination procedures established for the project. At a minimum, the cable, probes and MGX unit must be wiped clean of all mud and dirt.

Sondes and cable may remain connected between logging of different holes but should be placed securely in the vehicle when not in use. Turn Probe Power Off when disconnecting.

Remove the tripod from the hole. Unless otherwise specified for the project, place covered buckets containing decontamination material in the vehicle. Clean-up the area around the hole, and LOCK WELL if necessary.

### 8.6 Data Processing

No further processing of data is generally required, although LOGSHELL offers numerous options (logarithmic plots, smoothing, editing). Post-field processing usually includes setting optimum scales and putting different types of logs on the same plot.

### 8.7 Field Change Request

Variation from established procedure requirements may be necessary due to unique circumstances encountered on individual projects. All variations from established procedures shall be documented on Field Change Requests (Exhibit C) and reviewed by the Project Manager and the QA Manager.

The Project Manager may authorize individual Field Engineers to initiate variations as necessary. If practical, the request for variation shall be reviewed by the Project Manager and the QA Manager prior to implementation. If prior review is not possible, the variation may be implemented immediately at the direction of the Field Engineer, provided that the Project Manager is notified of the variation with 24 hours of implementation, and Field Change Request is forwarded to the Project Manager and QA Manager for review within 2 working days of implementation. If the variation is unacceptable to either reviewer, the activity shall be re-performed or action shall be taken as indicated in the Comments section of the checklist.

All completed Field Change Requests shall be maintained in project records.

## **8.8 Documentation**

All completed field logs, logging forms, and field change requests shall be forwarded to the project files.



**EXHIBIT A**

PROJECT DATA	HOLE DATA
COMPANY: _____	HOLE NO.: _____
PROJECT AREA: _____	DEPTH REFERENCE: _____
PROJECT NO: _____	TOP OF PROTECTIVE CASING: _____ FT
LOCATION: _____	TOP OF CASING: _____ FT
DATE LOGGED: _____	DEPTH DRILLED: _____ FT
TIME: _____	PROBE TD: _____ FT
	FLUID LEVEL: _____ FT
	BOTTOM OF CASING: _____ FT
	HOLE DIAMETER: _____ IN
	CASING DIAMETER: _____ IN
	REMARKS: _____

EXHIBIT B

PROJECT DATA		HOLE DATA	
COMPANY: _____		HOLE NO.: _____	
PROJECT AREA: _____		DEPTH REFERENCE: _____	
PROJECT NO: _____		TOP OF PROTECTIVE CASING: _____ FT	TOP OF CASING: _____ FT
LOCATION: _____		DEPTH DRILLED: _____ FT	PROBE ID: _____ FT
DATE LOGGED: _____		FLUID LEVEL: _____ FT	BOTTOM OF CASING: _____ FT
TIME: _____		HOLE DIAMETER: _____ IN	CASING DIAMETER: _____ IN
REMARKS: _____			

LOG TYPE: _____	FILE NAME: _____
SPEED: _____ FT/MIN	DIRECTION: " UP " DOWN
TOH = _____ - _____ = _____	AT: _____
BOH = _____ AT: _____; TOH = _____	AT: _____
COMMENTS	

LOG TYPE: _____	FILE NAME: _____
SPEED: _____ FT/MIN	DIRECTION: " UP " DOWN
TOH = _____ - _____ = _____	AT: _____
BOH = _____ AT: _____; TOH = _____	AT: _____
COMMENTS	

LOG TYPE: _____	FILE NAME: _____
SPEED: _____ FT/MIN	DIRECTION: " UP " DOWN
TOH = _____ - _____ = _____	AT: _____
BOH = _____ AT: _____; TOH = _____	AT: _____
COMMENTS	

Golder Associates Inc.

## EXHIBIT C

## FIELD CHANGE REQUEST

**Job/Task Number:** \_\_\_\_\_

---

**Procedure Reference:**

**Other Affected Documents:** \_\_\_\_\_

Requested Change: \_\_\_\_\_

Reason for Change: \_\_\_\_\_

Change Requested by: \_\_\_\_\_ Date \_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date: \_\_\_\_\_

## Project Manager

**Comments:**\_\_\_\_\_

Reviewed by: \_\_\_\_\_ Date \_\_\_\_\_

## QA Manager

Comments: \_\_\_\_\_

**Attachment B4**  
**Packer Testing Procedures**

## **PACKER TESTING PROCEDURES**

### **Introduction**

Drill stem (packer) testing was originally developed by the petroleum industry for the testing and assessment of reservoir productivity. In recent years, drill stem testing has become increasingly popular in the environmental industry due to its effectiveness in determining aquifer properties in low permeability rock, in a manner which is both more efficient and more accurate than most other aquifer testing methods. Outlined below is a brief description of packer testing procedures and equipment and methods used in the analysis of packer test results.

### **Packer Testing Set-up**

Briefly, the packer testing at the Site will be completed using a double packer assembly with three pressure transducers to monitor hydraulic head conditions above, below and within the test section; or, a single packer system which eliminates the bottom packer and transducer. The remainder of the text describes the double packer system. The packer assembly consists of a pair of inflatable rubber cylinders separated by a section of perforated steel pipe. When the packers are inflated, a test zone within the corehole is isolated from the rest of the corehole. Water is then allowed to flow in or out of the test zone via the perforated pipe, under controlled conditions using a shut-in valve. A schematic diagram of the packer testing is presented in Figure 1. The test interval length will be in the range of 10 feet to 20 feet based on the amount of stratigraphic and lithologic variability observed in the core.

### **Borehole Drill Stem Packer Testing Procedures**

The general packer testing procedure is as follows:

- 1) Lower the packer assembly to the required depth;
- 2) Record the pressure transducer readings and measure the water level inside the drill rods;
- 3) Inflate the packers using compressed nitrogen;

- 4) Measure the stable water level inside the drill rod (i.e., the potentiometric level of the test zone), then, close the downhole shut-in valve;
- 5a) Add potable water to the drill rods above the shut-in valve in preparation for the falling head test, or
- 5b) Pump water out of the drill rods in preparation for a rising head test (appropriate for shallow or above-ground potentiometric levels);
- 6) Open the shut-in valve allowing water in the drill rods to enter the test section;
- 7) Monitor the change in head with time (flow period/falling head test);
- 8) In tight formations, close the downhole shut-in valve to complete the "shut-in" testing and monitor recovery; and
- 9) Deflation/opening of all valves and packers.

Figure 2 illustrates a Typical Packer Test Plot, which was created to illustrate the response of the pressure transducers to the changes in head during a typical packer test event. Transducers T1, T2, and T3 are noted on Figure 2, and monitor the pressure head above, within, and below the test section, respectively. The narrative below explains in detail the steps involved on Figure 2 during a typical packer test, and the elapsed time in which they occur on this particular plot:

- Steps 1 and 2 are completed before an elapsed time of 0 on the Typical Packer Test Plot.
- At the initiation of the test, the packers are inflated (Step 3), and small pressure pulses are observed at each transducer location (seen at an elapsed time of 0 to 4 minutes). These pulses are caused by the displacement of water in the borehole as the packer expands.
- At an elapsed time of approximately 4 minutes, the "shut-in" valve is closed to isolate the test section (Step 4). This causes a sharp decrease in the pressure head recorded by transducer T2, because the test section has been isolated from the effects of vertical gradients, etc., that occur above or below the test section. This pressure decrease is observed during an elapsed time of 4 to 16 minutes. The drop in pressure head occurs when the "shut-in" valve is closed, and T2 is allowed to equilibrate to the static head within the test section (15-30

minutes). At this point in the test (an elapsed time of 16 minutes), the static head of transducer T2 can be determined. The reasons for the sudden drop in head at transducer T2 are the elimination of wellbore storage effects and the presence of downward gradients in this particular test. This response is variable, depending on the permeability of the rock unit being tested.

- A volume of potable water is then added to the drill rods that suspend the packer system in the borehole (Step 5).
- The water is released into the test section by opening the "shut-in" valve, to create a "falling head" affect (Step 6)(seen at elapsed time of approximately 16 minutes). A rapid increase in pressure is observed at transducer T2. This sudden increase in pressure is created by the water pressure applied to the isolated test section when the valve is opened.
- This addition of water creates a "flow period" (Step 7) into the isolated test section (at an elapsed time of 16 minutes to 37 minutes). The water entering the test section attempts to equilibrate as quickly as possible, but the low permeability of the rock unit in this particular test section prevents this. Therefore, the decrease in head throughout the "flow period" is minimal. The "flow period" is allowed to continue for either one-third of recovery or approximately 15 to 30 minutes.
- At an elapsed time of approximately 37 minutes, the "shut-in" valve is closed again (Step 8), isolating the test section (transducer T2). This allows the pressure head in the test section to return to static conditions, because the test section is isolated from any influences (i.e., vertical gradients, etc.). From an elapsed time of approximately 37 minutes to 59 minutes, the "shut-in" period is allowed to continue, ideally until the head level recorded for T2 reaches static conditions (maximum 30 minutes) (for this particular test, this occurred at an elapsed time of approximately 55 minutes to 59 minutes).
- At the end of the "shut-in" period (at an elapsed time of approximately 60 minutes), the valve is opened again, which constitutes the end of the test. The packers are deflated (elapsed time of approximately 59 minutes to 63 minutes). The head values recorded for each transducer return to static borehole conditions (elapsed time of approximately 63 minutes) when the packers fully deflate, as illustrated on Figure 1.

Other information to note on the typical packer test plot is the pressure recorded at transducer T1 remains essentially stable at a static head value of approximately 1188 feet above mean sea



level (FT-MSL). Transducer T1 is located above the isolated test section, and should be unaffected by the "flow" and "shut-in" periods which create pressure head changes that are recorded at transducer T2. The head values recorded for transducer T3 decrease at the beginning of the test (from an elapsed time of 2 minutes to 10 minutes) and stabilize to static conditions throughout the remaining portion of the test. The observed stabilization of the head values at transducer T3 verifies that the borehole length below the test section has been isolated from influences such as vertical gradients, etc. The static head values determined within each test section (T2) and below each test section (T3) can be used to determine the vertical gradients within the bedrock. The presence of transducers T1 and T3 also aids in detecting leakage above, below or within the straddle packer system. The types of leakage that can occur during drill stem testing are as follows:

- 1) Leakage of water through the drilling rods above the test section at the threaded joints. This can be noted by an increase in pressure recorded by transducer T1, but can also be noted as a drop in the water level inside the drill rods after they are filled;
- 2) Leakage into the test section at the threaded joints of the packer assembly, which is evident by pressure changes recorded by transducer T2 during the addition of water to the drill rods; and
- 3) Leakage around either the top or bottom packer, caused from a poor seal between the packers and the borehole wall, which can be observed by a change in recorded pressures for transducer T1, T2 or T3 during any of the packer testing steps.

#### **Packer Testing Analysis Methods**

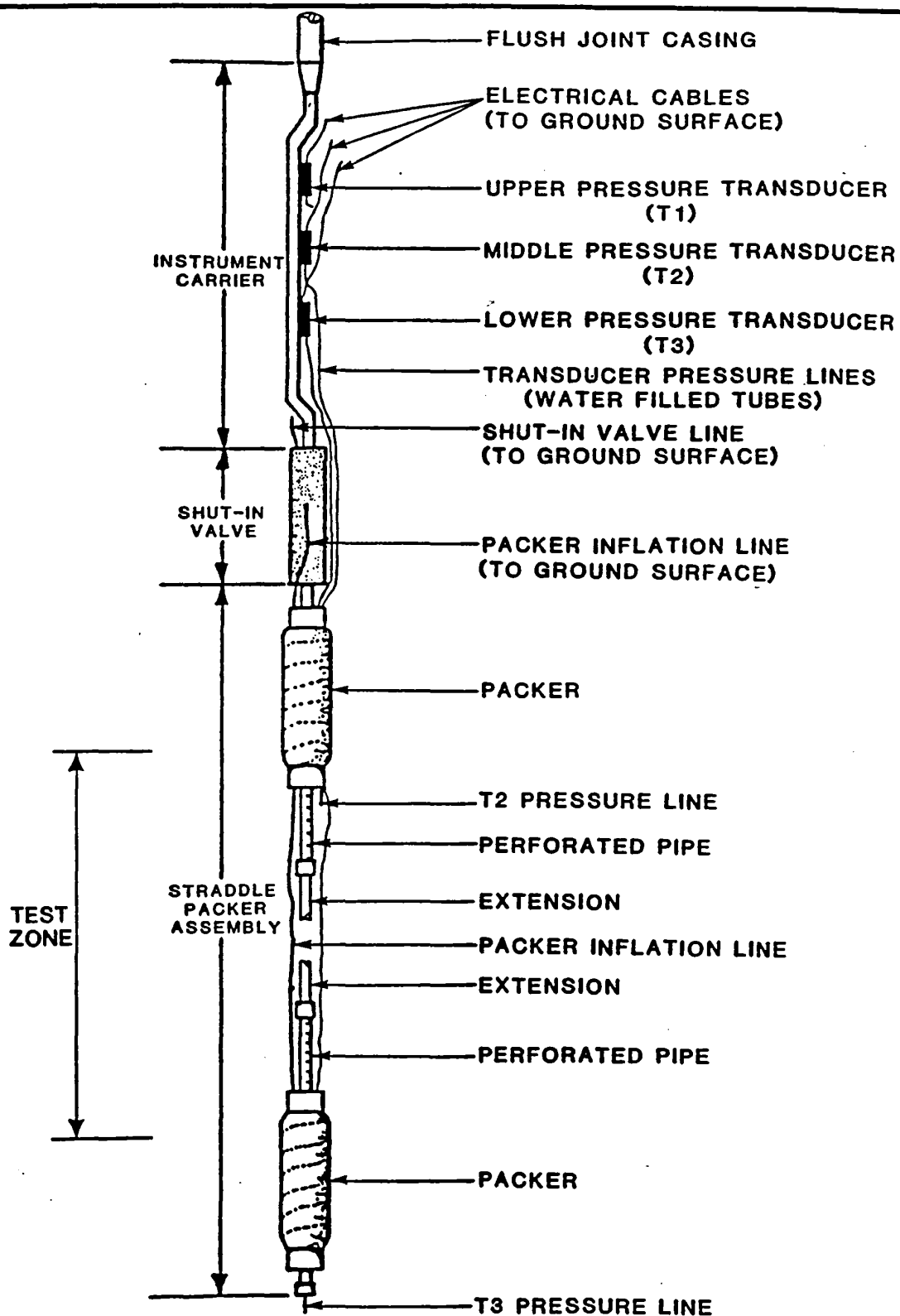
The packer assembly that will be used for the hydrogeologic testing program includes a shut-in valve that allows instantaneous flow in or out of the test zone (flow phase of the test). In addition, the shut-in valve can instantaneously isolate the test zone from any external stress (shut-in or recovery phase of the test). The implementation of variable head testing (flow phase) followed by recovery (shut-in phase) is expected to provide data for the characterization of the aquifer properties and type of flow system (homogeneous, dual porosity, dual

permeability, or composite flow). During the flow period, variable head tests (rising or falling) will be completed. This phase of the test will be analyzed with appropriate methods which will include: Hvorslev (1951), Bouwer and Rice (1976), or Papadopoulos and Cooper (1967). The recovery phase data will be analyzed with Horner method (1977). The diagnosis of flow regime will be made by using the semilog derivative of the hydraulic head data (Bourdet et.al, 1989; Ostrowski, et.al., 1989). Data from the "flow" and "shut-in" periods, as described above, are labeled on the Typical Packer Test plot (Figure 2).

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DR BY:	JSG	DATE:	05/26/95
CHK BY:	SOM	FILE No.:	NJ03-258
REV BY:	Rt	DR SUBTITLE:	03

### SCHEMATIC DIAGRAM OF STRADDLE PACKER ASSEMBLY

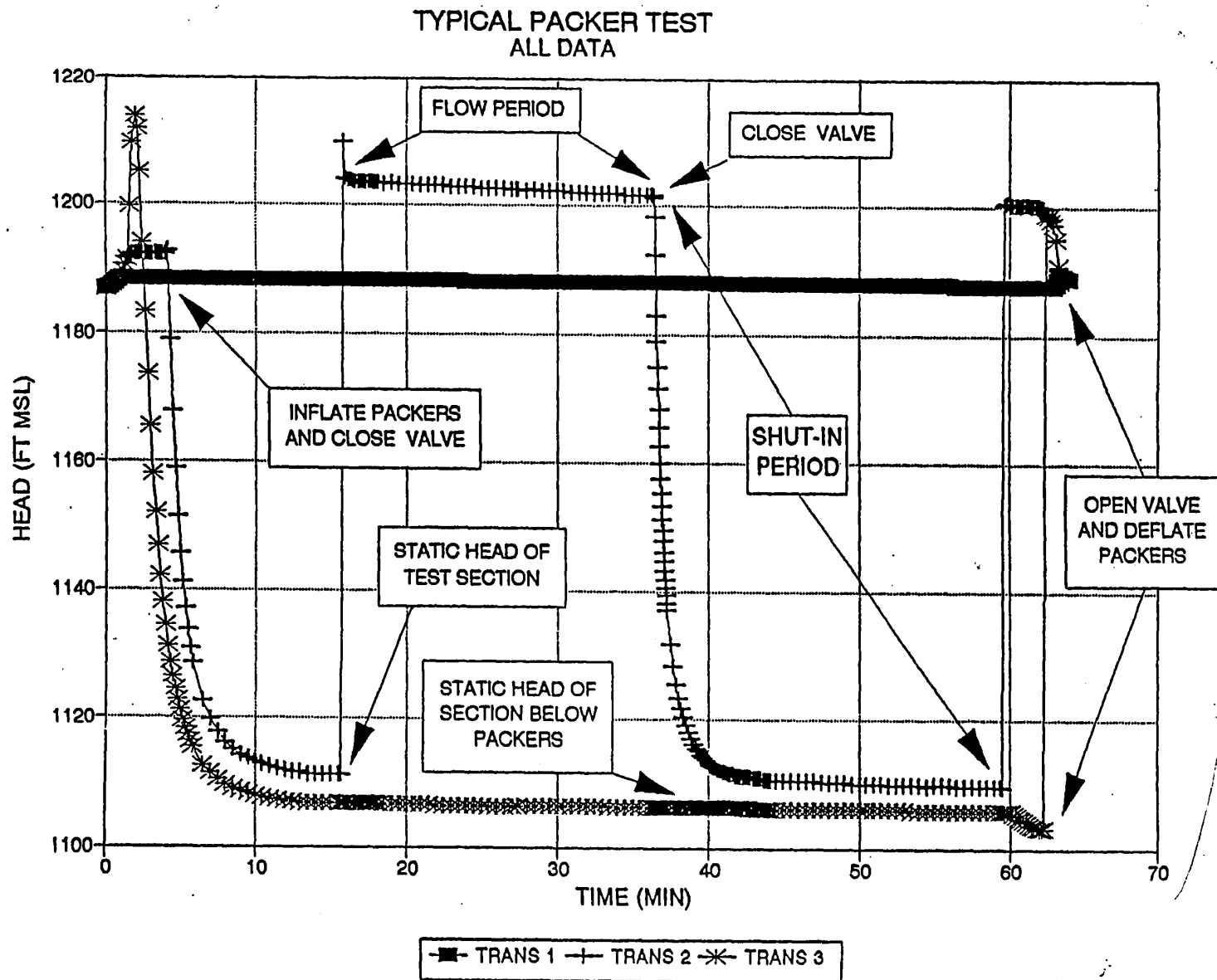
**Golder Associates**

216 PATERSON PLANK ROAD SITE

FIGURE

**1**

<b>Golder Associates</b>	JOB NO.:	943-6222	SCALE:	N/A
	DR BY:	JSG	DATE:	05/26/95
	CHK BY:	SDM	FILE NO.:	NJ03-261
	REV BY:	RJR	OR SUBSTITUTE:	03
<b>TYPICAL PACKER TEST DATA PLOT</b>				
216 PATTERSON PLANK ROAD SITE				
PAGE 2				



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**Attachment B5**  
**General Sampling Procedures**

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## **1.0 GENERAL SAMPLING CONSIDERATIONS AND DOCUMENTATION**

### **1.1 Purpose**

The General Sampling Considerations and Documentation requirements given in Sections 1.3 and 1.4 below are intended to guide the overall field sampling effort and produce valid sample results.

### **1.2 Equipment**

The following equipment and materials are required for this procedure:

- Sampling, Analysis and Monitoring Plan (SAMP);
- Quality Assurance Project Plan (QAPjP);
- Health and Safety Plan (HASP)
- Field notebooks (pages numbered consecutively);
- Water-proof markers;
- Sample collection forms;
- Chain-of-custody forms and seals;
- Sample bottle labels;
- Packing tape;
- Camera and film;
- Sampling gloves;
- Well keys;
- Well location map; and
- Well construction information.

### **1.3 Procedure**

#### **1.3.1 General Sampling Considerations**

- The main text of the SAMP should be consulted for information on existing site data, sampling objectives, sample locations and frequency, sample designations, sampling equipment and procedures, sample handling and planned analyses, and investigation-derived waste handling procedures. Much of the information in the main text of the SAMP is repeated in the procedures given below, but both sources of information should be reviewed prior to sampling.
- A new pair of phthalate-free powderless gloves (inner latex, outer NBR) should be worn by the sampler at each sample location.
- The minimum sample volumes given in the appropriate tables of the QAPjP are required to complete an analysis. The number and size of bottles have been specified to provide the laboratory with enough sample to perform two analyses for each parameter at a given sample point.

- If at any time the field team is in doubt as to the proper sampling procedures, the Golder Associates Project Manager or the Golder Associates Quality Assurance Officer should be contacted.
- Any changes to these procedures must be discussed with the Golder Associates Project Manager for approval in advance of implementation. The on-site representative of USEPA should also be consulted to document approval of the change using the Field Change Request Form.

### **1.3.2 Documentation**

- Proper documentation of field activities is essential. Required information for each sample includes:
  - Project or site name;
  - Sample collection date and time;
  - Sampler's name;
  - Sample point identification number and matrix;
  - Designation as a grab or composite sample;
  - Analysis method requested; and
  - Any sample filtration or preservatives used in the field.

The sample point identification, collection date/time, and requested analysis must be included on the sample bottle label. The individual collecting the sample should initial the bottle labels. All of the above information should be entered on the chain-of-custody form and sample collection forms.

- Objective field notes should be produced which summarize adherence to SAMP procedures and the chronology of events.
- Sample collection forms may be used to document much of the information in lieu of field notebooks. However, the sample bottle labels and chain-of-custody form should not be the only place where pertinent information is recorded in case discrepancies occur between the sample bottle labels and the chain-of-custody forms.
- Calibration of field meters should be documented including:
  - Analysts name;
  - Date and time of calibration;
  - Instrument type, model number, and serial number (if present); and
  - Manufacturer, concentration, and lot number of calibration standards which are used.

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- Each page of the field notebooks should contain the sampler's name, project number, and date. All field notes must be legible. Any errors should be crossed out with a single line and initialed.
  - Photographs should be taken of representative procedures. The condition of any damaged monitoring wells should also be photographed. Photographs must be documented in field notebooks including:
    - the photograph number;
    - photographer's name;
    - date/time;
    - description of subject; and
    - perspective.

This information should be transcribed onto the back of the photographs after they have been developed.

## **2.0 PROCEDURE FOR COLLECTION AND HANDLING OF QUALITY CONTROL SAMPLES**

### **2.1 Purpose**

Quality Control (QC) samples are used to evaluate the precision, accuracy, and representativeness of the sample data. A number of QC samples, such as trip blanks, equipment rinsate blanks, field duplicates, and matrix spike/matrix spike duplicates (MS/MSDs) are required for this project. Each of the above QC samples require special consideration by the sampling team. The various QC samples are identified in the SAMP. The on-site USEPA representative might also wish to collect split samples from the various sample locations, as well as QC samples for the split samples (i.e. field duplicates, MS/MSDs, rinsate blanks, trip blanks).

### **2.2 Equipment**

The following equipment and materials are required to perform this procedure:

- Demonstrated analyte-free water; and
- Sample bottles.

Trip blanks and equipment rinsate blanks are prepared using demonstrated analyte-free water supplied by the analytical chemistry laboratory. A batch analysis of the water will be supplied by the laboratory along with the water. The analytical results must be reviewed to evaluate whether it conforms to the project requirements prior to use. In order to be demonstrated analyte-free, the water analysis results should not detect any targeted analytes above the Contract Required Quantitation Limit (CRQL) for Target Compound List (TCL) organic compounds (including volatiles, semivolatiles, and pesticides/PCBs) and the Contract Required Detection Limit (CRDL) for inorganics (metals and cyanide). The CRQL and CRDL will be listed for each analyte on the analysis report.

As defined in the CLP SOW, exceptions to the above criteria are allowed for the following common laboratory contaminants: methylene chloride, acetone, toluene, 2-butanone, and the various phthalates. These common laboratory contaminants must not be detected at concentrations greater than three times the CRQL, but total volatile organics must be less than 10 parts per billion (ppb). All of the above compounds are VOCs except the phthalates.

The analytical results for the blank water must be kept on site during sampling in case USEPA wishes to audit the results. The analytical results should be placed in the project files in the home office after sampling is completed. Because demonstrated analyte-free water is also used in sampling equipment decontamination, the field team must be cognizant of the amount of water needed as the project progresses and notify the laboratory several days in advance if additional water is needed.

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**2.3 Procedure****2.3.1 General Considerations**

- Most QC samples (i.e. field duplicates and MS/MSDs) are collected at a frequency of one per batch of up to twenty field samples. A batch of up to twenty field samples is defined to include primary samples and field duplicate samples only. Equipment rinsate blanks are collected at a rate of one per decontamination event for each type of equipment used (not to exceed one per day per equipment type). Trip blanks, equipment rinsate blanks, and MS/MSD samples are not counted as part of the batch of twenty field samples.
- Both trip blanks and equipment rinsate blanks are required for this project. Trip blanks are required only for aqueous VOC samples. Trip blanks are prepared and shipped each day that aqueous VOC samples are collected.
- QC samples are preserved in the same manner as primary samples and must be stored in a cooler during the sampling day and shipment to the laboratory.

**2.3.2 Trip Blanks**

- Two VOC trip blank vials must be prepared each day that aqueous VOC samples are collected. The field team should send two trip blanks in case one breaks or contains air bubbles upon arrival at the laboratory.
- Trip blanks should be prepared at the start of the sampling day using demonstrated analyte-free water. The trip blanks are to be preserved in the same manner as field samples, taken along with the sample bottles to the various sample locations, and shipped to the laboratory along with the aqueous VOC samples collected that day. The vial must not contain any air bubbles.
- The chain-of-custody form should indicate that only one of the two trip blank vials is to be analyzed by the laboratory.

**2.3.3 Equipment Rinsate Blanks**

- Rinsate blanks should be collected after the equipment has been decontaminated as described in Section 2 above.
- Rinsate blanks are collected at frequency of one per decontamination event for each type of equipment used (not to exceed one per day per equipment type).
- Rinsate blanks should be collected for all analytical parameters.
- If a bailer is used to collect groundwater samples, a bailer rinsate blank should be collected.

**2.3.4 Field Duplicates, MS/MSDs, and Split Samples**

- Field duplicates and MS/MSD samples are required for all matrices at a rate of one per 20 field samples.
- Field duplicates should be collected for all analytical parameters.
- Field duplicates must be submitted blind to the laboratory (i.e. given similar but unique sample point identification numbers).
- Duplicate measurements of field parameters (temperature, pH, specific conductance, dissolved oxygen, and turbidity) should be performed at least twice each day per matrix sampled, or at a rate of one per twenty field samples, whichever is greater.
- MS/MSDs are actually extra sample volume for an existing sample. Therefore, the multiple sample bottles for MS/MSD analysis should be labeled in an identical manner, and the chain-of-custody form should indicate that this sample is designated for MS/MSD analysis.
- Sample bottles for split samples (also sample bottles for field duplicates and extra sample bottles for MS/MSDs) should be filled one parameter at a time (i.e. all the VOC bottles, then all the metals bottles, etc.).



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### **3.0 PROCEDURE FOR SAMPLE PRESERVATION**

#### **3.1 Purpose**

The following procedure should be followed to preserve environmental samples for laboratory analysis such that the representativeness of the sample is maintained prior to analysis to the extent possible.

#### **3.2 Equipment**

The following equipment and materials may be required to perform this procedure:

- Frozen blue ice packs or wet ice;
- Spare sample bottles;
- Several eye droppers;
- pH test strip paper;
- 30% hydrochloric acid (HCl);
- 30% Sulfuric acid (H<sub>2</sub>SO<sub>4</sub>);
- 30% Nitric acid (HNO<sub>3</sub>); and
- 10N Sodium hydroxide (NaOH).

#### **3.3 Procedure**

##### **3.3.1 General Requirements**

- Sample preservation requirements are given for aqueous samples in tables in the QAPjP.
- Aqueous samples should be cooled to 4°C in a cooler immediately after collection. This temperature should be maintained during storage and shipment to the laboratory.
- Filtration of groundwater samples for dissolved metals analysis should be performed prior to placement into the sample bottle and preserving. If filtration of samples for dissolved metals analysis is performed the filtration apparatus will be made of polyethylene, polypropylene or borosilicate glass. The apparatus will be decontaminated in accordance with procedures used for dedicated equipment with the exception of the organic solvent rinse. An equipment rinsate blank of the apparatus will be taken for dissolved metals analysis.
- Sample preservation kits will be provided by the laboratory along with the sample bottles.
- It should be noted that some samples, such as VOCs, require addition of hydrochloric acid (HCl) while others, such as metals, require the addition of nitric acid (HNO<sub>3</sub>) and others, such as ammonia, require addition of sulfuric acid

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(H<sub>2</sub>SO<sub>4</sub>). Cyanide samples should be preserved using NaOH. Be certain that the proper chemical preservative is added to each jar.

- Separate procedures for preservation of VOC and non-VOC samples are provided below.

### 3.3.2 VOC Samples

- An extra aqueous VOC sample vial should be filled at each sample location. The preservation procedure for aqueous VOC samples is given below.
- The extra sample vial will be used to determine the number of drops of HCl required to attain a pH less than 2.
- Initially, six drops of HCl should be added.
- The vial cap should be replaced and the vial inverted several times to mix the sample.
- The cap should be removed and a pH indicator strip dipped into the vial.
- The color of the strip should be compared to the color chart provided with the strips.
- Repeat the above procedure until a pH less than two has been attained. HCl should be added one drop at a time.
- Discard the test vial, and carefully add the same number of drops of acid to the remaining VOC vials.
- Replace the cap and invert each vial several times to mix the sample.
- If the sample effervesces upon addition of the acid, the sample should be submitted to the laboratory without the addition of HCl, but it should be cooled to 4°C. The lack of preservative, and the consequent 7 day technical holding time, should be specified in the comments section of the chain-of-custody form.

### 3.3.3 Non-VOC Samples

- Non-VOC samples should also be checked to assess the required amount of chemical preservative to attain the pH specified in the appropriate QAPjP table.
- Separate sample bottles are not required to check the pH because non-VOC sample bottles are permitted to contain headspace. The preservation procedure is given below.

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- Initially, four drops of preservative should be added.
  - The cap should be replaced and the bottle inverted several times to mix the sample.
  - A few milliliters of sample should be poured into a separate container (e.g. an unused sample jar cap) and the pH checked using indicator paper.
  - Additional acid should be added two drops at a time and the above procedure repeated until the specified pH is attained.
  - For cyanide samples, sodium hydroxide (NaOH) pellets might be supplied by the laboratory. These pellets should be added one at a time, and the sample mixed until the pellet has completely dissolved.
  - After some of the initial samples have been preserved, the sampler can increase the initial number of drops (or pellets) added if necessary based upon the approximate amount of sample required for other locations.

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**4.0 PROCEDURE FOR FIELD CHAIN-OF-CUSTODY****4.1 Purpose**

Samples are physical evidence collected from a facility or the environment. Sample data generated during environmental projects may be used as evidence in legal enforcement proceedings. In support of potential litigation, chain-of-custody procedures have been established to ensure sample traceability from the time of collection through completion of analysis.

**4.2 Equipment**

The following equipment and materials may be needed to perform chain-of-custody procedures:

- Chain-of-custody forms;
- Chain-of-custody seals; and
- A secure (locked) vehicle or building.

**4.3 Procedures**

- Chain-of-custody is usually initiated in the field by the sampling team.
- When chain-of-custody is initiated at the laboratory, the laboratory personnel responsible for shipping sampling containers will have initiated and signed the chain-of-custody form and sealed the shipping container with a chain-of-custody seal. It is preferable for the custody seal to be signed and dated by the laboratory and to have a unique serial number which is recorded on the chain-of-custody form by the lab. In such cases, field staff should check this information to assess the potential for tampering with sample containers prior to receipt in the field. The field staff should acknowledge receipt and container integrity by signing the chain-of-custody form, and noting any discrepancies.
- It is preferable to use laboratory-supplied sample containers. The bottles for this project will be supplied by the laboratory. CompuChem purchases their bottles from Eagle-Pitcher who prepares the glassware in accordance with OSWER directive # 9240.0-05A. Eagle-Pitcher provides CompuChem with certificates of cleanliness; copies of these certificates will be provided with the bottles to the field sampling crew. However, if a situation arises where the field team uses any sample containers not supplied by the laboratory (such as pre-cleaned and certified I-Chem bottles), this should be noted on the chain-of-custody form for the particular samples in question.
- Samples and sample containers must be kept under proper chain-of-custody during field sampling. The National Enforcement Investigations Center (NEIC) of USEPA considers a sample in custody under the following conditions:

- It is in your actual possession; or
  - It is in your view, after being in your physical possession; or
  - It was in your possession and then you locked or sealed it to prevent tampering; or
  - It is in a secure area (such as a locked site trailer, or a locked site vehicle).
- If custody of the samples (and sample bottles) is exchanged during field sampling, such transfer must be documented on the chain-of-custody form. The departing field staff should sign indicating the custody has been relinquished, and the arriving field staff should sign indicating responsibility for the custody of the samples.
- Each sample bottle label should include:
    - Project name and code;
    - Sample point identification number;
    - Sample collection date/time;
    - Analytical method to be performed; and
    - Initials of individual collecting the sample.
- The chain-of-custody form and sample collection forms should include:
    - Sample identification number and matrix;
    - Project or site name;
    - Sampler's name;
    - Sample date and time (military time);
    - Designation as a grab or composite sample;
    - Requested analysis;
    - Whether the sample was filtered;
    - Any preservatives added to the sample; and
    - Any special notations regarding the sample.
- When shipping samples to the laboratory, all sample bottles and requested analyses should be noted on the chain-of-custody form.
- Where multiple analytical methods are available for a particular analysis, the specific method number should be listed on the chain-of-custody form. For example, groundwater samples for VOC analysis might be performed by USEPA Methods 601, 602, 624, or CLP-RAS (Contract Lab Program-Routine Analytical Services).
- Any sample filtering or preservation should be noted on the chain-of-custody form.
- If required and appropriate for the project, the chain-of-custody form must indicate whether there are any additional target analytes for TCL analysis. It should also indicate where triple sample volume has been supplied for MS/MSD analysis.

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- The form should also note that only one of the two trip blank vials should be analyzed by the laboratory.
  - The sampling technician should sign the chain-of-custody form relinquishing custody to the laboratory.
  - Record the airbill number on the chain-of-custody form in the comments section.
  - The field sampling crew should keep one copy of the completed chain-of-custody form along with a copy of the airbill.
  - The chain-of-custody form should be sealed inside the shipping container with the samples. The paperwork should be sealed inside a ziplock bag to prevent damage from water condensation or broken sample bottles.
  - The courier does not need to sign the chain-of-custody form if it is sealed within the shipping container using custody seals.
  - If samples are hand delivered to the laboratory by the field staff, the chain-of-custody form should be signed at the laboratory when the samples are delivered and the shipping container does not need to be sealed as long as it is kept under proper chain-of-custody until delivered to the laboratory.
  - If possible, chain-of-custody seals should be signed and dated, and the serial numbers listed on the chain-of-custody form. At least two seals should be used on each shipping container.
  - Field staff should return their copy of the chain-of-custody form to the project office as soon as possible. If field records are sent via U.S. mail or overnight courier, the field staff should keep another copy of the form until receipt by the project office has been confirmed.



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**5.0 PROCEDURE FOR SAMPLE SHIPPING****5.1 Purpose**

The following procedure is to be used to enhance successful shipping of samples to the laboratory.

**5.2 Equipment**

The following equipment and materials may be required to perform this procedure:

- Overnight courier airbills and courier phone number;
- Fiber reinforced strapping tape;
- Cushion material such as bubble wrap or vermiculite;
- Address labels;
- Laboratory address and phone number; and
- Custody seals.

**5.3 Procedure**

- Samples should be packed into a shipping container (usually a cooler) in a manner which will minimize potential breakage of sample bottles. This might include use of laboratory-supplied bubble wrap designed to fit the particular bottle, polystyrene chips, or vermiculite.
- The sample containers must contain enough frozen blue ice packs to maintain a temperature of 4°C during transport to the laboratory.
- For aqueous VOC samples, be sure that a trip blank has been included.
- Record the airbill number of the overnight courier on the chain-of-custody form in the comments section.
- The field sampling crew should keep one copy of the completed chain-of-custody form along with a copy of the airbill.
- The chain-of-custody form should be sealed inside the shipping container with the samples. The paperwork should be sealed inside a ziplock bag to prevent damage from condensation of water or broken sample bottles during shipping.
- The courier does not need to sign the chain-of-custody form if it is sealed inside the shipping container using custody seals.
- If samples are hand delivered to the laboratory by the field staff, the chain-of-custody form should be signed at the laboratory when the samples are

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delivered and the shipping container does not need to be sealed as long as it is kept under proper chain-of-custody until delivered to the laboratory.

- If possible, chain-of-custody seals should be signed and dated, and the serial numbers listed on the chain-of-custody form. At least two seals should be used on each shipping container.
- Samples must be shipped to the laboratory within 24 hours of collection. For local laboratories, courier service or drop off at the laboratory may be available. Otherwise samples should be shipped via overnight delivery service (e.g., Federal Express). Samples collected on Friday must be shipped for Saturday delivery. Verify with the laboratory that someone will be at the laboratory to receive the samples.
- Field staff should return their copy of the chain-of-custody form to the project office as soon as possible. If field records are sent via U.S. mail or overnight courier, the field staff should keep another copy of the form until receipt by the project office has been confirmed.
- The field sampling team should notify the Golder laboratory coordinator of the quantity and types of samples shipped each day as soon as possible. If there are discrepancy on the paperwork received by the laboratory, or if any sample bottles are received broken, the laboratory will notify the Golder laboratory coordinator, who will subsequently consult with the Golder Project Manager and Golder Quality Assurance Officer to determine if resampling is necessary.

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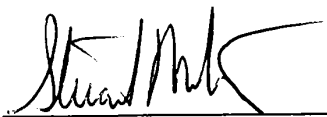
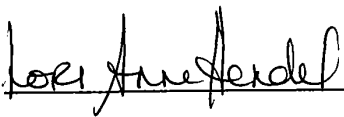
**APPENDIX C**  
**Quality Assurance Project Plan**

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN  
FOR OFF-PROPERTY INVESTIGATION  
216 PATERSON PLANK ROAD SITE  
CARLSTADT, NEW JERSEY

December 1995

Revision # 0

	Signature	Date
Golder Associates Project Manager		12/21/95
Golder Associates Project QA Manager		95/221

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## 1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPjP) has been prepared by Golder Associates Inc. (Golder Associates) as part of the Work Plan Amendment (Work Plan) for an Off-Property Investigation for the 216 Paterson Plank Road Site (Site) in Carlstadt, New Jersey. This document describes the policy, organization and specific quality assurance (QA) and quality control (QC) elements necessary to achieve the objectives defined for the Investigation. This QAPjP is primarily intended to address QA/QC procedures which will govern chemical analysis (field and laboratory) of environmental samples which will be collected from the Site during Investigation.

This QAPjP was prepared in accordance with the USEPA guidance documents specified below:

1. Interim Guidelines for Preparing Quality Assurance Project Plans (EPA-600/4-83-004, QAMS-005/80), dated February, 1983;
2. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (EPA/540/G-89/004), dated October, 1988;
3. EPA NEIC Policies and Procedures Manual (EPA 330/9-78-001-R) dated May 1978, revised May 1986; and
4. Data Quality Objectives for Remedial Response Activities -Development Process (EPA/540/ G-87/003), dated March, 1987; and
5. Region II CERCLA Quality Assurance Manual, USEPA, Final Copy, Revision 1, October 1989.

The guidance documents specify fifteen (15) essential elements to be included in a QAPjP. The first two (2) elements, Title Page (with provision for approval signatures) and the Table of Contents are included in the front of this document. The remaining thirteen (13) elements are presented in Sections 2 through 15.

CompuChem Environmental Corporation (CompuChem) of Research Triangle Park, North Carolina is anticipated to provide primary analytical chemistry services to this project. CompuChem is a current Contract Laboratory Program (CLP) participant for organic and inorganic analysis and is certified by the New Jersey Department of Environmental Protection (NJDEP). In addition, CompuChem is currently providing analytical testing services in connection with ongoing monitoring at the site.

Many of the quality assurance procedures to be used for this project are described in the following documents:

1. Contract Laboratory Program (CLP) Statement of Work (SOW) for Organic Analysis (OLM03.1);
2. CLP SOW for Inorganic Analysis (ILM03.0);
3. CLP Organics Data Review and Preliminary Review, USEPA Region II SOP HW-6, Revision 9, December 1994;
4. Evaluation of Inorganic Data for the CLP, USEPA Region II SOP HW-2, Revision 11, January 1992; and
5. CompuChem Environmental Corporation Quality Assurance Plan (QAP), April 1994.

CompuChem's QAP has been provided as Attachment C1 to this QAPjP. New Jersey certification for CompuChem is included in Attachment C2. CompuChem's QAP describes specific QA procedures which will be used for this project, as well as information regarding personnel, management structure, analytical equipment and instrumentation, and the laboratory facility. Where conflicting information appears in the main text of the QAPjP as compared to the text in the CompuChem's QAP, the information from the main text shall prevail.

The text of this document, which presents each of the thirteen remaining elements of a QAPjP, refers to the CompuChem QAP, CLP SOWs and the Work Plan including the Sampling, Analysis and Monitoring Plan (SAMP, Appendix B of the Work Plan). This approach is in accordance with USEPA guidance documents which require that referencing of other documents be clearly defined in order to facilitate location of required information. Each section of this QAPjP provides references to these documents as appropriate.

The signatures on the cover sheet of this QAPjP demonstrate the review, approval, acceptance and responsibility for the Quality Assurance/Quality Control procedures specified herein by the project team. A list of key personnel determined thus far for this project is presented as Table C1 of this QAPjP.

All laboratories used during this project will be required to adhere to the provisions of this QAPjP. The primary analytical laboratory chosen for this project (CompuChem) is a participant in good standing in the EPA's CLP Program and has demonstrated its ability to perform all tasks required under the CLP. Any revisions to this QAPjP will be submitted to USEPA Region II for approval prior to implementation.

## **2.0 PROJECT DESCRIPTION**

The purpose of the project is to implement an Off-Property Investigation, which includes monitoring well installation, groundwater sampling, hydrogeologic and geophysical testing. Implementation of the project consists of the following tasks:

- Installation of pressure transducers in select monitoring wells and a Steven's recorder-type device (or equivalent) in Peach Island Creek to monitor long-term water level fluctuations;
- Completion of one deep bedrock pilot borehole;
- Installation of four bedrock monitoring wells (MW-8R, MW-10R, MW-11R, and MW-14R), four wells screens within till/weathered bedrock (MW-10D, MW-14D, MW-15D, and MW-16D), and one well each in the till (MW-17D) and weathered bedrock (MW-18D) at off-property locations;
- Conduct hydrogeologic testing in the newly installed monitoring wells;
- Collection of groundwater samples from the newly installed monitoring wells;
- Collection of groundwater samples for PCE and TCE "fingerprint compounds" at two depths in monitoring wells MW-5D, MW-7D, and MW-11D;
- Conduct borehole geophysical testing in existing and select newly installed monitoring wells; and,
- Other field procedures required to completed the items above (e.g., decontamination, water level measurements, etc.).

Sampling to be performed under this project is summarized in Table C2. Groundwater monitoring well samples will be analyzed for Target Compound List (TCL) and Target Analyte List (TAL) constituents.

### **3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES**

The project will be performed by a qualified team of contractors retained by the Cooperating PRP Group. The Project Team organization is shown on Figure C1. Addresses and phone numbers for the key members of the project team are provided in Table C1 of this QAPjP. It should be noted that these individuals have primary responsibility for the project although other individuals may be involved. The chain of communication shown on Figure C1 of the QAPjP will be followed throughout the project.

The lead regulatory agency for the Site is the United States Environmental Protection Agency (USEPA) Region II. Golder Associates is the primary contractor responsible for the Investigation. Analytical chemistry services, will be provided by CompuChem Environmental Corporation of Research Triangle Park, North Carolina. Drilling and surveying contractors will be used as needed.

CompuChem's QAP (dated March 1995) is provided as Attachment C1. CompuChem's organizational structure is described in Section 4 of the QAP.

#### **4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT**

As part of the evaluation component of the QA program, results are compared with certain data quality indicators. These data quality indicators are part of the overall DQOs for the project. DQOs for groundwater analysis for samples from the off-property monitoring wells are provided on Table C3. Table C4 provides details regarding the planned chemical analyses. QA program objectives for the analytical laboratory are presented in Sections 5 and 14 of CompuChem's QAP. In general, data quality indicators include precision, accuracy, representativeness, completeness, and comparability (PARCC). Each indicator may be defined as follows:

1. Precision is the agreement or reproducibility among individual measurements of the same property, usually made under the same conditions;
2. Accuracy is the degree of agreement of a measurement with the true or accepted value;
3. Representativeness is the degree to which a measurement accurately and precisely represents a characteristic of a population, parameter, or variations at a sampling point, a process condition, or an environmental condition;
4. Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct normal conditions; and
5. Comparability is an expression of the confidence with which one data set can be compared with another data set in regard to the same property.

QA objectives vary according to the specific objectives of each analysis. The levels of QA effort associated with the various types of analyses for a project such as this one are provided on Table C3. The accuracy, precision and representativeness of data will be functions of the sample origin, analytical procedures and the specific sample matrices. Quality Control (QC) practices used to evaluate these data quality indicators include use of accepted analytical procedures, adherence to hold time, and analysis of QC samples



such as blanks, replicates, spikes, calibration standards and reference standards. Tables C5 and C6 summarize the PARCC criteria for groundwater samples which will be collected for laboratory and field measurements. Analytical reporting limits are provided in Attachment C3.

For each parameter analyzed, quantitative QA objectives for precision, accuracy and sensitivity (detection limits) were established in accordance with EPA CLP protocols (where appropriate), published historical data, laboratory method validation studies and laboratory experience with similar samples.

Representativeness is a non-quantitative (qualitative) characteristic which primarily addresses proper design of a sampling program in terms of number and location of samples and sample collection techniques. The rationale for the number and location of samples for this project is discussed in Section 5.0 of the Work Plan. Groundwater sampling procedures are described in the SAMP. The representativeness of the analytical data is also a function of the procedures used to process the samples. Wherever possible, standard USEPA or USEPA-accepted analytical procedures will be followed.

Completeness is a quantitative characteristic which is defined as the fraction of valid data obtained from a measurement system (sampling and analysis) compared to that which was planned. Completeness can be less than 100 percent due to poor sample recovery, sample damage, or disqualification of results which are outside of control limits due to laboratory error or matrix-specific interferences. Completeness is documented by including sufficient information in the laboratory reports to allow the data user to assess the quality of the results. For this project, every attempt will be made to attain 80% completeness or better (field and laboratory) if chemical analysis is required. The completeness goal for laboratory measurements will be 85%.

Comparability is a qualitative characteristic which allows for comparison of analytical results with those obtained by other laboratories. This may be accomplished through the use of standard accepted methodologies, traceability of standards to National Bureau of Standards (NBS) or USEPA sources, use of appropriate levels of quality control, reporting results in consistent, standard units of measure and participation in inter-laboratory studies designed to evaluate laboratory performance.

Groundwater samples collected during the project will be analyzed for parameters provided in Table C2. The DQOs, as summarized by the PARCC criteria on Tables C5 and C6, may not always be achievable. The USEPA Region II data validation guidelines provide direction for the determination of data usability. Qualified data can often provide useful information, although the degree of certainty associated with the results may not be as planned. Professional judgment will be used to determine data usability with respect to project goals.

## **5.0 SAMPLING PROCEDURES**

The ultimate accuracy of any data generation begins with a sampling and measurement procedure which is well conceived and carefully implemented. The details of the groundwater sampling procedures are provided in the SAMP (Appendix B of the Work Plan). The SAMP presents the procedures with which samples will be acquired or measurements made during the execution of the project.

### Changes in Procedures

Any major changes in sampling procedures as outlined in the SAMP and QAPjP will be discussed with the PRP Group Facility Coordinator. Approval from the USEPA Remedial Project Manager will be needed prior to implementation of any major changes. Minor procedural changes will be made with the concurrence of the on-site USEPA representative. Changes will be documented in the field log books.

### Acquisition of Samples

The groundwater sampling procedures discussed in the SAMP and Attachment B5 address the following items as they have been determined thus far:

- A description of the planned sampling locations;
- A description of the specific groundwater sampling procedures to be used;
- A description of containers, procedures, reagents, etc., used for sample collection, preservation, transport and storage (Attachment B5);
- A description of sample preservation methods (Section 3.0 of Attachment B5);
- A discussion of the time considerations for shipping samples promptly to the laboratory (Sections 4.0 and 5.0 of Attachment B5);
- Examples of the custody or chain-of-custody procedures and forms (see Figure C2 and Section 4.0 of Attachment B5);

- A description of the forms, notebooks, and procedures to be used to record sample history, sampling conditions, and analyses to be performed (Figure C2, Attachment B2 and Attachment B5); and
- A discussion of field QC checks such as field blanks, trip blanks, etc. (Section 2.0 of Attachment B5).

All samples shall be adequately marked for identification from the time of collection and packaging through shipping and storage. Marking shall be on a sample label attached to the sample container. Sample identification shall include, as a minimum:

- Project name and code;
- Sample identification number;
- Analysis requested;
- Sample date and time; and
- Initials of the individual performing the sampling (samples for chemical analysis).

Each sample will be assigned a unique sample identification number to be recorded on the sample label. Each sample identification number will be recorded in a sample log and, as applicable, on chain-of-custody documentation (see Figure C2). Designations for sample identification numbers for this project are described in the SAMP.

The methods and references for collecting samples are provided in the SAMP. Appropriately prepared sample containers are supplied by the laboratory. Reagents, preservation procedures and analytical holding times will be in accordance with the published analytical methods and USEPA Region II guidelines. Aqueous VOC samples will be checked at each well to ensure adequate acid has been added to attain pH <2. An extra VOC vial at each well will be used for this test and discarded (i.e., not sent to the laboratory).

The specific requirements for sample container preparation, sample preservation, and holding times, and any special sample handling requirements are listed in Table C7. Sample containers will be kept closed until the time each set of sample containers are to be filled. After filling, the containers will be securely closed, residue wiped from the sides of the containers, and immediately placed in a cooler. Samples will be kept chilled and shipped on the day of sample collection to the laboratory via overnight delivery service. Samples of dissimilar matrices will be shipped in separate coolers, whenever possible.

## **6.0 SAMPLE CUSTODY**

Samples are physical evidence collected from a facility or the environment. Sample data generated during this project may be used as evidence in USEPA enforcement proceedings. In support of potential litigation, chain-of-custody procedures have been established to ensure sample traceability from the time of collection through completion of analysis.

The National Enforcement Investigations Center (NEIC) of USEPA considers a sample to be in custody under the following conditions:

1. It is in your possession; or
2. It is in your view after being in your possession; or
3. It was in your possession and you locked it up; or
4. It is in a designated secure area.

All environmental samples will be handled under strict chain-of-custody procedures beginning in the field. The field sample custodian (team leader) will be responsible for ensuring that the applicable procedures outlined in of the SAMP (including Attachment B5) and relevant sections of this QAPjP are followed. Sample custody for field activities will include the use of chain-of-custody forms, sample labels, custody seals, and field notebooks. Field notebooks will be used throughout the project to document all phases of field activities. Supplies and reagents (source and lot numbers, if appropriate) used for field measurements will be recorded in the field notebooks. An example of the Chain-of-Custody document to be used during sample collection is presented as Figure C2 of this QAPjP. The CompuChem Chain-of-Custody form is provided in Section 7 of the CompuChem QAP.

Once samples are transported to the analytical laboratory, custodial responsibility is transferred to the Laboratory Sample Manager to assure that the procedures presented in the laboratory's QAP and the appropriate CLP SOW are followed. Sections 6 and 7 of CompuChem's QAP discuss laboratory Chain-of-Custody procedures.

The laboratory will keep final evidence files containing all relevant and appropriate project sample information. This sample information includes, but is not limited to the following items:

1. Chain-of-custody records;
2. Sample log-in information (if applicable);
3. Copies of laboratory sheets;
4. Copies of bench sheets;
5. Instrument raw data printouts;
6. Chromatograms;
7. Pertinent correspondence memoranda; and
8. Final report file.

Golder Associates will retain all relevant and appropriate project information in project files. The information contained in these files includes, but is not limited to, the following items:

1. Chain-of-custody records;
2. Field notes and information;
3. Correspondence and telephone memoranda;
4. Meeting notes;



5. Laboratory information;
6. Data validation information;
7. Reference information;
8. Audit information; and
9. Copies of reports.

These files will be retained for a minimum of six years as specified in the Administrative Order.

## **7.0 CALIBRATION PROCEDURES**

Calibration procedures and frequency of calibration are described in the laboratory's QAP (Section 8) and in the SAMP and represent accepted techniques to ensure accurate sampling, monitoring, testing and documentation of field work as per quality assurance/quality control standards. Field instruments, such as pH meters and specific conductivity meters, will be standardized/calibrated in accordance with the manufacturers' recommendations against NBS traceable standards, where appropriate. During sampling, calibration will occur at the beginning and end of each day and at least every four hours. Duplicate field measurements will be performed at a frequency of once per twenty samples or at a minimum of twice per sampling day, whichever is greater. Table C5 provides precision criteria for field duplicate measurements. Appropriate calibration records will be maintained in project field notebooks. The field team leader is responsible for ensuring that calibrations are properly performed at the appropriate frequency.

The major chemical analytical equipment used for this project are described in the CompuChem QAP and the CLP SOWs. A laboratory QAP provides information regarding types of equipment used by the laboratory facility. Section 13 of the CompuChem QAP contains this information. While the laboratory follows all specified procedures in the USEPA CLP SOW, various sources for calibration are used (for example, USEPA repository, NBS, Supelco, Aldrich and Chem Service). Sections 8 and 18 of the CompuChem QAP describes laboratory procedures for procurement of standard reference materials. The laboratory assures traceability of all stock solutions and working standards back to the neat material.

Groundwater samples may contain elevated levels of target analytes. These samples cannot be analyzed undiluted because the calibration range of the method would be exceeded. In accordance with the CLP SOW, these samples would require analysis at dilutions which will elevate the quantitation limits. Samples which do not contain

concentrations of target analytes which exceed the instrument calibration range should be analyzed undiluted to achieve the lowest possible quantitation limits.

## 8.0 ANALYTICAL PROCEDURES

Most site characterization samples collected during this project will be analyzed, as appropriate, using CLP methodologies. Where CLP methodologies do not exist, samples will be analyzed using EPA-accepted methodologies. Non-CLP methodologies for both chemical and physical testing will be from the following documents:

Standard Methods for the Examination of Water and Waste Water, 18th Edition, APHA, Washington D.C., 1992;

Annual Book of ASTM Standards, Volumes 04.08 and 04.09, American Society of Testing and Materials, Philadelphia, PA, 1995; and

Annual Book of ASTM Standards, Part 31-Water, American Society of Testing and Materials, Philadelphia, PA, 1981.

CLP methods will be performed in accordance with the following documents:

USEPA Contract Laboratory Program, Statement of Work for Inorganic Analyses, Multi-media, Multi-concentration, (ILM03.0); and

USEPA Contract Laboratory Program, Statement of Work for Organic Analysis: Multi-media, Multi-concentration, (OLM03.1).

Method references for the analyses to be performed for this project are summarized in Table C7. For sample analyses that are identified in Table C4, TCL/TAL analyses will be performed by CompuChem. Information regarding the laboratories' equipment is presented in Section 13 of the QAP. Laboratory qualifications (audit and/or performance evaluation results and certifications) are available from the laboratory.

## **9.0 DATA REDUCTION, VALIDATION, AND REPORTING**

A detailed presentation of the laboratory data reduction, validation and reporting procedures is included in Section 10 of CompuChem's QAP. Reporting limits and units for each target parameter on the TCL/TAL lists are specified in the CLP SOWs and in Attachment C1. The equations and/or procedures used to calculate concentrations are specified in the individual methodologies (refer to Table C7 for method numbers and references). Field measurements are taken in accordance with the manufacturers' directions and little to no calculation is performed. Field measurements and any calculations needed are recorded in field notebooks which will be stored in the Golder Associates project files. A table providing a summary of field measurements associated with sampling events will be created to accompany the analytical data. Laboratory data files are stored at the laboratory.

For samples analyzed using CLP protocols, the laboratory will produce data packages which conform to the requirements of the CLP SOW. Data validation for data generated by CLP methodologies will be performed by the Golder Associates data validation specialist identified in Table C1. Data validation will be performed in accordance with the following current guidance documents specified by USEPA Region II:

1. USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, February, 1994;
2. USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, February, 1994;
3. Region II Standard Operating Procedure (SOP) No. HW-6, Revision 9 - CLP Organics Data Review and Preliminary Review, December, 1994; and
4. Region II SOP - No. HW-2, Revision 11 - Evaluation of Inorganic Data for the Contract Laboratory Program (CLP), January, 1992.

Qualified results will be reported for CLP samples on the forms provided in the CLP report packages or as data summary tables along with the laboratory deliverable package. Qualified results, data packages and analytical results will be stored in Golder Associates' project files. CLP deliverables, and raw data and batch QC for inorganic indicator parameters will be available for USEPA inspection at Golder Associates' Mt. Laurel, NJ office. A three (3) day advance notification to Golder Associates is requested to retrieve all appropriate files prior to USEPA inspection.

Precision, accuracy, representativeness, comparability, and completeness will be evaluated based upon field sampling documentation, adherence to hold times and analysis of QC samples (duplicates, spikes and blanks). PARCC criteria are specified in Tables C5 and C6. QA review will be based upon method-specific QC criteria similar to the criteria in Section 8 of the EPA series methods in 40 CFR Part 136 using the premises described in the Region II SOPs for data validation. Qualifiers will be applied to the data using the logic specified in the SOPs. Raw data (i.e. bench sheets) and batch QC data will also be reviewed. The overall responsibility for reporting laboratory data lies with the laboratory managers.

The PARCC criteria and/or the criteria specified in the guidelines may not always be achievable. The data validation guidelines provide directions for the determination of data usability. Qualified data can often provide useful information, although the degree of certainty associated with the result may not be as planned. Professional judgment will be used to determine data usability with respect to DQOs and project goals.

## **10.0 INTERNAL QUALITY CONTROL**

The laboratory chosen for this project (CompuChem) has an established quality control check program utilizing procedural (method) blanks, laboratory control spikes, matrix spikes, and duplicates. Details of the Internal QC checks utilized are specified in the CLP SOW and the laboratory's QAP (Section 11). Additional quality control will be performed utilizing trip blanks, and rinsate or field blanks. These QC samples will be used to determine if sample constituents may be attributed to field activities or procedures used in sample transportation. Assessment of laboratory QC will take into account the PARCC criteria specified for this project (Tables C5 and C6). Attachment B5 of the SAMP discusses collection of QC samples (trip and rinsate blanks, field duplicates and MS/MSDs). Attachment B5 also discusses preservation procedures.

Split samples may be collected by a USEPA contractor during the project. These samples will be collected separately and analyzed by a laboratory other than the laboratory chosen by Golder Associates. The EPA may choose to compare the laboratory results from the split samples with the results reported by Golder Associates' chosen laboratory for the same sample points. This comparison will demonstrate how well the results reported by two different laboratories are replicated.

The field activities will be performed in strict accordance with the procedures provided in the SAMP. Field instruments will be calibrated/standardized at the beginning of each day and after every four hours of use. Duplicate field measurements will be made for one out of each twenty samples but no less than twice per day. Field or equipment rinsate blanks will be collected and analyzed to assess if sample contamination may be attributed to field activities. Control limits for accuracy and precision of field QC check samples may be found on Tables C5 and C6. The acceptable overall measurement error may be quantitatively expressed by the precision and accuracy goals for the data (Table C5 and C6) which are representative of both sampling and analytical error.



## **11.0 PERFORMANCE AND SYSTEM AUDITS**

### **11.1 Performance**

Performance of activities or procedures will be maintained by the personnel responsible for such activities and procedures. For field measurements, the field team leader will be responsible for performance while the analyst and sample custodian will be responsible for performance within the laboratory. The performance of activities or procedures must comply with those specified in this QAPjP and the SAMP. The responsible personnel must be prepared to justify that the specified procedure or reference method was implemented properly. Any deviation of a technical procedure or reference method must be noted within the appropriate log book and, for laboratory analyses, in the Case Narrative of the analytical report.

Reports regarding laboratory performance are discussed in Section 12 of CompuChem's QAP. The chosen laboratory is a current CLP participant for both organic and inorganic analyses and has demonstrated that it can perform all the tasks required by the CLP. The USEPA Contract Laboratory Program (CLP) requires successful performance of pre-award Performance Evaluation (PE) samples prior to acceptance into the program. Once established in the program, a laboratory must continue to demonstrate performance capabilities by successfully analyzing blind samples sent by the USEPA at designated intervals. The laboratory also participates in the water supply and/or water pollution series of PEs sponsored by the Quality Assurance Branch of USEPA. Successful analysis of these samples is required as part of the laboratory certification process for the environmental agencies for several states.

Performance will be monitored in the field through the use of QC checks as previously discussed in Section 10. Performance will be monitored in the laboratory through the use of QC checks discussed in Section 11 of the laboratory QAP and the PARCC criteria presented on Tables C5 and C6.

## **11.2 Audits**

The QA/QC audit is an independent systematic on-site review of facilities, equipment, training procedures, record keeping, data validation, data management, and reporting aspects of the field and laboratory QA/QC program. Audits may be performed on field operations and sampling procedures, laboratory analyses and documentation.

### **11.2.1 Field/Sampling Audit**

Golder Associates does not plan an internal audit of field sampling activities as they are limited and will be performed in the course of doing other field activities. The field team leader will be responsible for ensuring that the applicable quality assurance procedures described in Attachment B5 of the SAMP and this QAPjP are followed. Field activities may be audited by the on-site USEPA representative, with respect to the technical requirements, procedures, and protocols established in the SAMP. These include:

Well installation activities, such as:

- Equipment decontamination;
- Quality of materials used in well installation;
- Well placement technique; and
- Logging/field record keeping.

Field sampling activities, such as:

- Documentation of activities (logbooks, etc.),
- Use of proper sampling equipment;
- Proper sample identification;
- Sample preservation;

- Sample packaging;
- Sample shipment; and
- Chain-of-custody.

#### **11.2.2 Laboratory Audits**

The laboratory anticipated for this project (CompuChem) has been audited by the EPA and the NJDEP. The laboratory Quality Assurance Department will routinely conduct internal audits. Section 12 of the CompuChem QAP discusses internal laboratory audits. Golder Associates will not be performing audits of the laboratories during the project. However, if an external audit is deemed necessary by the USEPA, the USEPA and/or the USEPA oversight contractor will be responsible for their implementation. The most recent audit by the USEPA is provided in Attachment C1.

## 12.0 PREVENTIVE MAINTENANCE

Preventive maintenance of equipment is essential if project resources are to be utilized in a cost-effective manner. Preventive maintenance will ensure accuracy of measurement systems, minimize downtime, and provide inventory control of critical spare parts, back up systems, and other necessary equipment. Golder Associates will maintain an inventory of replacement parts for field instruments, and will routinely perform preventive maintenance or repair. Spare parts that often require replacement will be kept on hand at the Site during field activities. The following table summarizes the preventive maintenance approach for specific pieces of equipment used in field sampling, monitoring, testing and documentation.

### EQUIPMENT & ACCESSORIES

### PREVENTIVE MAINTENANCE AND INVENTORY

#### Groundwater Monitoring and Testing Equipment

pH meters	Check batteries and electrode prior to use; spare batteries, electrodes and buffer solutions (4.0, 7.0).
Specific conductance meters	Check batteries and sensor prior to use; spare batteries and calibration solution.
Water level indicator meters	Check batteries and condition of tape measure prior to use; spare batteries.
Sample bottles, containers	Check prior to use for cleanliness, breakage and cracks; spare bottles; spare coolers; spare preservatives.
Distilled water	Spare distilled water.
Graduated buckets	Spare buckets.
Drill rigs	Check prior to use for cleanliness and leaking fluid; spare tools.

**Split spoon**

**Check prior to use for cleanliness and to ensure soil catcher is properly attached; spare split spoon samplers, spare soil catchers.**

**Preventive maintenance of laboratory equipment and hardware is described in Section 13 of the CompuChem QAP. This section and the CLP SOW describe the instruments and equipment required to be present at the laboratory. More than one instrument is generally available for each type of analysis in case the initial instrument malfunctions or does not meet the required measurement criteria. Preventive maintenance and repair will be performed by laboratory personnel or qualified manufacturer representatives.**

### 13.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA

Assessment of accuracy, precision and completeness of both field and laboratory measurements is based upon the acceptable results from QC samples. Where appropriate these may include blanks, duplicate samples, laboratory control spiked samples or matrix spike/matrix spike duplicate samples.

Method, field/rinsate, and trip blanks are expected not to contain any target analytes with concentrations greater than the reported detection limit with the possible exception of common laboratory contaminants.

Field and laboratory duplicate results are assessed based upon relative percent difference (RPD) between values, using the following equation:

$$RPD = \frac{(D1 - D2)}{(D1 + D2)/2} \times 100\%$$

where, D1 = Primary sample result; and,  
D2 = Duplicate sample result.

Laboratory control spiked samples are assessed based upon the percent recovery (%R) of spiked analytes. The percent recovery is calculated using the following equation:

$$\%R = \frac{X}{TV} \times 100\%$$

where, X = observed value of measurement; and,  
TV = "true" value of spiked analyte.

Matrix spike/matrix spike duplicate (MS/MSD) data are assessed based upon the percent recovery of spiked analytes using the following equation:

$$\% R = \frac{(SSR - SR)}{SA} \times 100\%$$

where, SSR = Spiked sample result for analyte x;  
SR = Sample result for analyte x; and,  
SA = Spike added of analyte x.

The relative percent difference between the MS/MSD results is calculated using the RPD equation presented above.

Data completeness is assessed based upon the amount of valid data obtained from a particular measurement system (sampling and analysis). It may be quantitatively expressed using the following equation:

$$\text{Completeness} = \frac{N1}{N2} \times 100\%$$

where, N1 = number of valid measurements obtained; and,  
N2 = number of valid measurements expected.

Section 14 of the CompuChem's QAP describes the procedures which the laboratory uses internally to assess data which is produced. The laboratory assesses all quality control data with regard to precision and accuracy. Corrective actions are initiated as necessary.

Individuals making field measurements will determine whether or not field quality control criteria on Table C5 were met. The field quality assurance and quality control will be overseen by the field team leader. Corrective actions will be initiated as necessary.

Laboratory analytical data and field data will be assessed by a Golder Associates data validation specialist to determine usability with regard to the DQOs which will be established for any sampling required. The data validation specialist is identified in Table C1. As mentioned in Section 9 of this QAPjP, USEPA Region II guidelines will be used to validate CLP deliverables. PARCC criteria are presented on Tables C5 and C6.



As noted in the data validation guidelines, data may not always meet precision and accuracy requirements but may still be considered usable. The data will be assessed with regard to the project DQOs, and professional judgment will be used in determining data usability.

#### **14.0 CORRECTIVE ACTIONS**

The need for corrective action is based upon predetermined limits for acceptability for all aspects of data collection and measurement. Predetermined limits for acceptability may include but are not limited to the PARCC criteria (Tables C5 and C6), historical data, laboratory control spike sample results, and experience using the analytical procedures for measurement in relation to the specific methodologies. By following standard quality control/quality assurance procedures, problems which could result in erroneous data can be detected. The need for corrective action may be determined by the samplers, analysts, supervisors, quality assurance personnel, laboratory managers or Project Managers.

Section 15 of CompuChem's QAP describes the Corrective Action procedures and documentation used by the laboratory to eliminate problems in the analytical systems. Any problems which can not be resolved by the analysts, laboratory managers or quality assurance officers will be brought to the attention of the Project Managers. The Golder Associates Project Manager, PRP Group Facility Coordinator, and USEPA Project Manager will determine the corrective action to be taken, if any.

The laboratory personnel will assess laboratory QC samples and re-analyze samples which do not meet QC criteria prior to expiration of hold times, when possible. Corrective actions for samples not meeting QC criteria may include re-analysis, or resampling and analysis. Laboratory personnel will use corrective action reporting forms to document identification and resolution of defects. These report forms will be kept on file in the laboratory QA files.

The detection of system and performance problems and the corrective actions procedures used in the field during sample collection and data measurement will be documented in the field log books and placed in the project files. Any problems which can not be resolved by the sampler or field team leader will be brought to the attention of the Project Manager.

The Golder Associates Project Manager, PRP Group Facility Coordinator, and USEPA Project Manager will determine the corrective action to be taken, if any.

If a system or performance audit uncovers problems requiring corrective action, the corrective action will be initiated upon approval of the responsible supervisor(s) and documentation of corrective actions will be made in a letter report to the Program Managers/Coordinator. In this case, corrective actions will be reported to the Golder Associates Quality Assurance Officer and Project Manager, the PRP Group Facility Coordinator, the USEPA Quality Assurance Officer, and Region II Project Manager.

## **15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT**

Timely Quality Assurance reports are necessary to the successful completion of this project. Quality assurance deficiencies in the field must be reported to the field team leader and the Golder Associates QA and project managers. Quality assurance deficiencies in the laboratory must be reported in a timely manner to laboratory and project management personnel. Expeditious initiation of corrective action will minimize the loss of data and time. Sections 4 and 16 of CompuChem's QAP discuss the laboratory's policies and procedures for reporting quality assurance activities to management. As mentioned in Section 14 of this QAPjP, corrective actions for field and laboratory activities will be reported to the Golder Associates Quality Assurance Manager and Project Manager, the PRP Group Facility Coordinator, and the USEPA Quality Assurance Officer and Region II Project Manager.

In accordance with the Administrative Order, the PRP Group Facility Coordinator will provide monthly progress reports to USEPA which will include summary of actions taken to achieve compliance with the Administrative Order and tasks set forth in the Work Plan, results of sampling, tests and validated analyses, identification of plans and deliverables submitted to the Agencies, description of problems encountered, any corrective actions taken during the preceding month and a description of data gathering and other activities planned for the upcoming two months. Any changes which need to be made to the QAPjP will be noted in the progress report. Prior to initiation and implementation, these changes will be discussed with the USEPA Project Manager.

TABLE C1

## KEY PERSONNEL

EPA Remedial Project Manager:	Richard Puvogel USEPA Region II New Jersey Superfund Branch I 290 Broadway, 19th Floor New York, NY 10007-1866 Telephone: (212) 637-4372
Facility Coordinator 216 Paterson Plank Road Cooperating PRP Group	P. Stephen Finn Golder Associates Inc. 305 Fellowship Rd. Suite 200 Mt. Laurel, NJ 08054 Telephone: (609) 273-1110 Fax: (609) 273-0778
Golder Project Manager:	Robert J. Illes Golder Associates Inc. 305 Fellowship Rd. Suite 200 Mt. Laurel, NJ 08054 Telephone: (609) 273-1110 Fax: (609) 273-0778
Golder Quality Assurance Officer:	Lori Anne Hendel Golder Associates Inc. 305 Fellowship Rd. Suite 200 Mt. Laurel, NJ 08054 Telephone: (609) 273-1110 Fax: (609) 273-0778
Golder Laboratory Coordinator:	Stuart D. Mitchell Golder Associates Inc. 305 Fellowship Rd. Suite 200 Mt. Laurel, NJ 08054 Telephone: (609) 273-1110 Fax: (609) 273-0778

TABLE C1

## KEY PERSONNEL

Laboratory Project Manager:	Diane Ellmore
Alternate Laboratory Project Manager:	Marlene Swift
	CompuChem Laboratories, Inc.
	3306 Chapel Hill/Nelson Highway
	Research Triangle Park, NC 27709
	Telephone: (800) 833-5097
	Fax: (919) 406-1686
Laboratory Quality Assurance Director:	Robert E. Meierer
Laboratory Quality Assurance Manager:	Linda Fowler
	CompuChem Laboratories, Inc.
	3306 Chapel Hill/Nelson Highway
	Research Triangle Park, NC 27709
	Telephone: (800) 833-5097
Golder Data Validator:	Lori Anne Hendel
	Golder Associates Inc.
	305 Fellowship Rd. Suite 200
	Mt. Laurel, NJ 08054
	Telephone: (609) 273-1110
	Fax: (609) 273-0778

**TABLE C2**  
**SUMMARY OF OFF-PROPERTY INVESTIGATION SAMPLING**

REMEDIAL INVESTIGATION				
SAMPLING POINTS	SAMPLING FREQUENCY	SAMPLING PARAMETERS	PURPOSE OF SAMPLING	DQO ANALYTICAL LEVELS (1)
<u>Monitoring Wells</u>  MW-8R MW-10D MW-10R MW-11R MW-14D MW-14R MW-15D MW-16D MW-17D MW-18D	Once during the additional Off-Property Investigation	TCL/TAL	To obtain groundwater quality data and determine potentiometric surface.	DQO Level 4 for TCL/TAL  DQO Level 1 for field parameters
MW-5D, MW-7D, MW-11D	Once	PCE,TCE	To assess potential inhomogeneity in contaminant transport	DQO Level 3

**Notes:**

- (1) DQO analytical levels are defined on Table C3 of the QAPjP.  
 (2) PCE = Tetrachloroethene    TCE = Trichloroethene



TABLE C3

## LEVELS OF QUALITY ASSURANCE AND ANALYTICAL DATA METHODOLOGIES

Level	Description	Associated Off-Property Activity
I	<p>Level I is the lowest quality data but provides the fastest results. Field screening or analysis provides Level I data. It can be used for health and safety monitoring and preliminary screening of samples to identify those requiring confirmation sampling (Level IV). The generated data can indicate the presence or absence of certain constituents and is generally qualitative rather than quantitative. It is the least costly of the analytical options.</p>	<ul style="list-style-type: none"> <li>- Health and safety monitoring</li> <li>- Field analyses</li> <li>- (pH, specific conductivity temperature)</li> </ul>
II	<p>Level II data are generated by field laboratory analysis using more sophisticated portable analytical instruments or a mobile laboratory onsite. This provides fast results and better-quality data than in Level I. The analyses can be used to direct a removal action in an area, re-evaluate sampling locations, or direct installation of a monitoring well network.</p>	<ul style="list-style-type: none"> <li>- Not Applicable</li> </ul>
III	<p>Level III data may be obtained by a commercial laboratory with or without CLP procedures. (The laboratory may or may not participate in the CLP.) The analyses do not usually use the validation or documentation procedures required of CLP Level IV analysis. The analyzed parameters are relevant to site characterization risk assessment, and design of the remedial action.</p>	<ul style="list-style-type: none"> <li>- PCE, TCE screening</li> </ul>
IV	<p>Level IV data are used for risk assessment, engineering design, and cost-recovery documentation. All analyses are performed in a CLP analytical laboratory and follow CLP procedures. Level IV is characterized by rigorous QC protocols, documentation, and validation.</p>	<ul style="list-style-type: none"> <li>- Groundwater analysis of CLP TCL and TAL parameters.</li> </ul>
V	<p>Level V data are those obtained by nonstandard analytical procedures. Method development or modification may be required for specific constituents or detection limits.</p>	<ul style="list-style-type: none"> <li>- Not Applicable</li> </ul>
OTHER	Other Methodologies not described above.	<ul style="list-style-type: none"> <li>- Hydrogeological tests, i.e., Water level measurements</li> </ul>

(1) EPA DQO Guidance Documents.

**TABLE C4**  
**Off-Property Investigation - Target Analytes, Analytical Methods, and Quality Assurance Samples**  
**Groundwater Monitoring Program**

Parameters	Methodology	Number of Samples	Types of Samples
Volatile Organics	CLP SOW OLMO3.1	13 (note 3)	Primary
		1	Field Duplicates
		1 (note 1)	MS
		1 (note 1)	MSD
		1 (Note 2)	Field Rinsate Blanks
		1 daily (note 1)	Trip Blanks
Semi-volatile Organics	CLP SOW OLMO3.1	10	Primary
		1	Field Duplicates
		1 (note 1)	MS
		1 (note 1)	MSD
		1 (note 2)	Field Rinsate Blanks
Pesticide/PCB	CLP SOW OLMO3.1	10	Primary
		1	Field Duplicates
		1 (note 1)	MS
		1 (note 1)	MSD
		1 (note 2)	Field Rinsate Blanks
Total Metals / Cyanide	CLP SOW ILM03.0	10	Primary
		1	Field Duplicates
		1 (note 1)	MS
		1 (note 1)	MSD
		1 (note 2)	Rinsate Blanks
		1	Laboratory Duplicates

**Notes:**

1. The number of MS/MSD samples and trip blanks is dependent upon the sampling schedule which may be impacted by weather, field conditions and access restrictions.
2. Rinsate blanks are collected at a rate of one per decontamination event for each type of equipment (not to exceed one per day per equipment type).
3. Three (3) samples will be analyzed and reported for tetrachloroethene and trichloroethene only as described in Table C2.
4. CLP SOW OLM03.1 is the Organic Statement of Work.
5. CLP SOW ILM03.0 is the Inorganic Statement of Work.

**TABLE C5**  
**PARCC DATA FOR AQUEOUS SAMPLES**

MEASUREMENT PARAMETER	METHOD REFERENCE	LABORATORY PRECISION	FIELD & LABORATORY PRECISION	ACCURACY	COMPLETENESS (b)
Volatile Organics TCL	EPA-CLP	see Table C6	+/- 50%	see Table C6	85%
Semi-Volatile Organics-TCL	EPA-CLP	see Table C6	+/- 50%	see Table C6	85%
Pesticide/PCB-TCL	EPA-CLP	see Table C6	+/- 50%	see Table C6	85%
Total Metals-TAL	EPA-CLP	see Table C6	+/- 50%	see Table C6	85%
Total Cyanide-TAL	EPA-CLP	see Table C6	+/- 50%	see Table C6	85%
Specific Conductance	Electrode	NA	+/- 50%	NA (a)	85%
pH	Electrode	NA	+/- 0.5 std pH units	NA (a)	85%
Temperature	Thermometer	NA	+/- 0.5 deg C	NA (a)	85%

**NOTES:**

NA = Not applicable

TCL = CLP Target Compound List, see CLP Statement of Work OLM03.1.

TAL = CLP Target Analyte List, see CLP Statement of Work ILM03.0.

Precision expressed as either percent relative standard deviation (%RSD) or relative percent difference (%RPD).

Accuracy expressed as percent recovery of matrix spike or laboratory control sample.

Precision and accuracy for CLP parameters provided in Table C6.

Representativeness and Comparability are non-quantitative parameters.

Accuracy and precision criteria for laboratory measurements will be consistent with the criteria cited in the individual methodologies for the additional drinking water parameters.

(a) Accuracy goals that can not be defined as matrix spikes will not be performed on field parameters. Field meters will be standardized/calibrated every four hours at a minimum.

(b) While the goal for completeness of laboratory measurements is 85%, the goal for total completeness (sampling and analytical) is 80%.

TABLE C6

**LABORATORY ACCURACY AND PRECISION\* CRITERIA  
FOR AQUEOUS CLP SAMPLES**

<b>VOLATILE ORGANICS:</b>		<b><u>QC LIMITS</u></b>	
<b><u>Target Compound</u></b>	<b><u>% Recovery</u></b>		<b><u>% RPD</u></b>
1,1-Dichloroethene	61%-145%		0%-14%
Trichloroethene	71%-120%		0%-14%
Benzene	76%-127%		0%-11%
Toluene	76%-125%		0%-13%
Chlorobenzene	75%-130%		0%-13%
<b><u>Surrogate Compound</u></b>			
Toluene-d8	88%-110%		Not Applicable
Bromofluorobenzene	86%-115%		Not Applicable
1,2-Dichloroethane-d4	76%-114%		Not Applicable
<b>SEMIVOLATILE ORGANICS:</b>		<b><u>QC LIMITS</u></b>	
<b><u>Target Compound</u></b>	<b><u>% Recovery</u></b>		<b><u>% RPD</u></b>
Phenol	12%-110%		0%-42%
2-Chlorophenol	27%-123%		0%-40%
1,4-Dichlorobenzene	36%-97%		0%-28%
N-Nitroso-di-n-propylamine	41%-116%		0%-38%
1,2,4-Trichlorobenzene	39%-98%		0%-28%
4-Chloro-3-methylphenol	23%-97%		0%-42%
Acenaphthene	46%-118%		0%-31%
4-Nitrophenol	10%-80%		0%-50%
2,4-Dinitrotoluene	24%-96%		0%-38%
Pentachlorophenol	9%-103%		0%-50%
Pyrene	26%-127%		0%-31%
<b><u>Surrogate Compound</u></b>			
Nitrobenzene-d5	35%-114%		Not Applicable
2-Fluorobiphenyl	43%-116%		Not Applicable
Terphenyl-d14	33%-141%		Not Applicable
Phenol-d5	10%-110%		Not Applicable
2-Fluorophenol	21%-110%		Not Applicable
2,4,6-Tribromophenol	10%-123%		Not Applicable
2-Chlorophenol-d4	33%-110%	advisory only	Not Applicable
1,2-Dichlorobenzene-d4	16%-110%	advisory only	Not Applicable

TABLE C6

**LABORATORY ACCURACY AND PRECISION\* CRITERIA  
FOR AQUEOUS CLP SAMPLES**

<b>PESTICIDES:</b>		<b><u>QC LIMITS</u></b>	
<b><u>Target Compound</u></b>	<b><u>% Recovery</u></b>		<b><u>% RPD</u></b>
gamma-BHC (Lindane)	56%-123%		0%-15%
Heptachlor	40%-131%		0%-20%
Aldrin	40%-120%		0%-22%
Dieldrin	52%-126%		0%-18%
Endrin	56%-121%		0%-21%
4,4'-DDT	38%-127%		0%-27%
<b><u>Surrogate Compound</u></b>			
Tetrachloro-m-xylene	30%-150%		Not Applicable
Decachlorobiphenyl	30%-150%		Not Applicable
<b>INORGANICS:</b>		<b><u>QC LIMITS</u></b>	
<b><u>Target Analyte</u></b>	<b><u>% Recovery</u></b>		<b><u>% RPD</u></b>
Metals	75%-125%		0%-50% (a)
Cyanide	75%-125%		0%-50% (a)

**NOTES:**

- \* - Accuracy and Precision Criteria based upon CLP SOW OLM03.1 and ILM03.0 as well as Region II data validation guidelines.
- (a) - Maximum % RPD is 50% if concentration is greater than five times the Contract Required Detection Limit (CRDL). If the concentration is less than five times the CRDL, the precision limit is +/- the CRDL.

**TABLE C7**  
**ANALYTICAL METHODS, SAMPLE CONTAINERS, PRESERVATION AND**  
**ANALYTICAL HOLD TIMES FOR AQUEOUS SAMPLES**

PARAMETER	METHODOLOGY	CONTAINER	MINIMUM SAMPLE	PRESERVATION (d)	FIELD FILTERED	HOLD TIME (e)
Volatile Organics-TCL	CLP OLM03.1	3-40 ml G	3 - 40 ml	Cool 4 deg C;HCl,pH<2	No	14 days (a)
Semi-Volatile Organics-TCL	CLP OLM03.1	2-1000 ml G	1000 ml	Cool 4 deg C	No	7 days (b)
Pesticide/PCB-TCL	CLP OLM03.1	2-1000 ml G	1000 ml	Cool 4 deg C	No	7 days (b)
Total Cyanide-TAL	CLP ILM03.0	1-1000 ml P	1000 ml	Cool 4 deg C;NaOH,pH>12	No	14 days
Total Metals-TAL	CLP ILM03.0	1-500 ml P	250 ml	Cool 4 deg C;HNO3,pH<2	No	180 days (c)
Specific Conductance	Electrode	P or G	NA	None	No	Field Measurement
pH	Electrode	P or G	NA	None	No	Field Measurement
Temperature	Thermometer	G	NA	None	No	Field Measurement

**NOTES:**

- (a) If preservation is not possible due to foaming, both preserved and unpreserved sample will be collected if possible. The hold time will be 7 days for unpreserved sample.  
 (b) 7 days for extraction, 40 days for analysis after commencement date of extraction.  
 (c) Hold time for Mercury is 28 days.  
 (d) Sample Preservation is performed by sampler immediately upon sample collection.  
 (e) Hold time based upon day of sample collection not verified time of sample receipt.

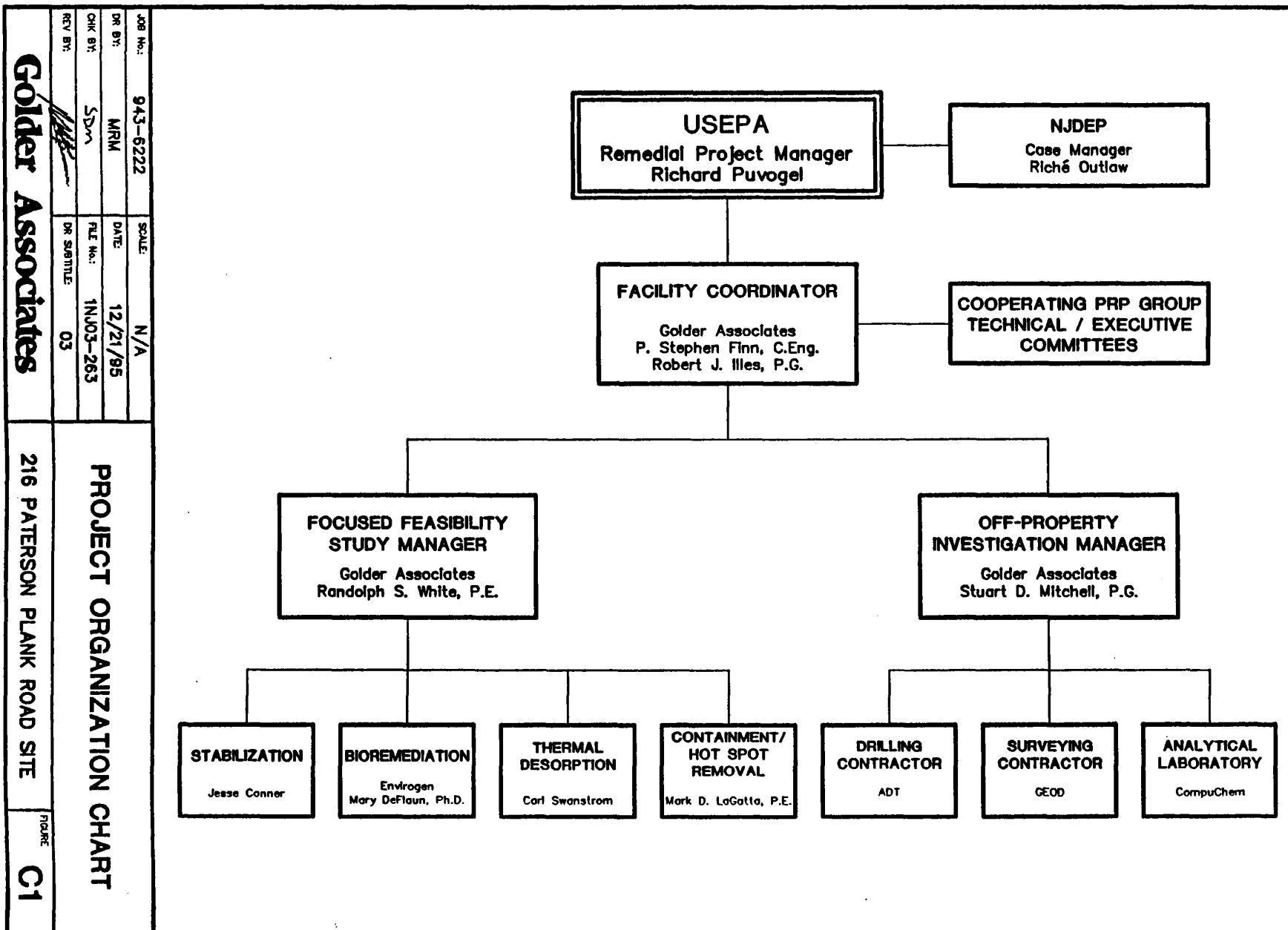
1. CLP SOW ILM03.0 is the Statement of Work for Inorganic Analysis.
2. CLP SOW OLM03.1 is the Statement of Work for Organic Analysis.

TCL = CLP Target Compound List

TAL = CLP Target Analyte List

P = Polyethylene

G = Glass







**COMPUCHEM**  
ENVIRONMENTAL  
CORPORATION

3306 Chapel Hill/Nelson Highway  
Research Triangle Park, NC 27709

1-800-833-5097

## FIGURE C2 CHAIN-OF-CUSTODY RECORD

No. 1000

Ship to:		Project Name:		Field Point-of-Contact:	
		Sampler Name:		Telephone No:	
Carrier		Airbill No.:		Sampling for project complete? Y or N (See Note 1.)	
		Sampler Signature:		Project-specific (PS) or Batch (B) QC: _____	
<b>Box #1:</b> 1. Surface Water 2. Ground Water 3. Leachate 4. Effluents 5. Soil/Sediment/Sudge 6. Trip Blank 7. Oil 8. Waste 9. Other: _____		<b>Box #2:</b> A. HCl B. HNO <sub>3</sub> C. NaHSO <sub>4</sub> D. Na <sub>2</sub> S <sub>2</sub> O <sub>8</sub> E. Ice Only F. Other: _____ G. Not Preserved		<b>Box #3:</b> F. Filtered U. Unfiltered	
		<b>Box #4:</b> C. CLP 300 S. SW-846 W. CWA 800-series L. Low Conc. CLP		<b>Box #5:</b> H. High M. Medium L. Low	

Sample ID (Organics: 9 characters max, Inorganics: 8 characters; see Note 2)	Date: Year: 19__	Time	Box #1	Box #2	Box #3	Box #4	Box #5	No. of Bottles	Use for Lab QC (MS or DUP)	Organics Analysis				Inorganics			Other				Remarks/Comments		
			Matrix	Preservative	Filtered/Unfiltered	Method	Expect. Conc.			VOA-GC/MS	SV-GC/MS	Pest/PCB-GC	Herb-GC	VOA-GC	Metals	Mercury	Cyanides	Radiologicals	TOC/TOX	O&G/TPH		Phenols	Other
	/	..																					
	/	..																					
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Client's Special Instructions:

Lab: Received in Good Condition? Y or N

Describe Problems, if Any:

#1 Relinquished By: (Sig.)	Date:	#2 Relinquished By: (Sig.)	Date:	#3 Relinquished By: (Sig.)	Date:	Sample storage time requested? _____ (In days, see Note 3)
Company Name:	Time:	Company Name:	Time:	Company Name:	Time:	
#1 Received By: (Sig.)	Date:	#2 Received By: (Sig.)	Date:	#3 Received By: (Sig.)	Date:	DESTROY or RETURN data after five years of archive? (Circle choice, see Note 4)
Company Name:	Time:	Company Name:	Time:	Company Name:	Time:	

Note (1): If "Y" lab will hold samples to await remainder of project-maximizing batch size and minimizing QC ratio; if "N" lab will begin processing batches now. Note (2): If CLP Inorganics database required, ID limited to maximum of six characters.

Note (3): Samples stored 60 days after data report mailed at no extra charge. Note (4): All lab copies of data destroyed after five years unless client requests and pays for return of copies; annual storage fee billed in January of year six.

R2-0000205

**Attachment C1**

**CompuChem's Standard Laboratory Quality Assurance Plan  
has been intentionally omitted from this copy.**

**Attachment C2**



STATE OF NEW JERSEY  
DEPARTMENT OF  
ENVIRONMENTAL PROTECTION AND ENERGY

Let's protect our earth



*Certifies That*

CompuChem Environmental Corporation  
3306 Chapel Hill/Nelson Highway  
Research Triangle Park, North Carolina 27709-4998

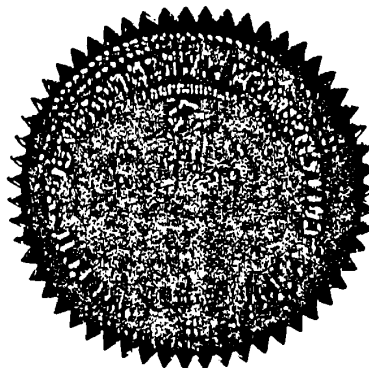
*having duly met the requirements of the  
Regulations Governing Laboratory Certification  
And Standards Of Performance N.J.A.C. 7:18 et. seq.*

*is hereby approved as a*

**State Certified Environmental Laboratory**

*To perform the analyses as indicated on the Annual Certified Parameter List  
which must accompany this certificate to be valid*

# 67249  
PERMANENT CERTIFICATION NUMBER  
January 18, 1994  
DATE



*Jeanne M. Fox*  
COMMISSIONER, DEPARTMENT OF  
ENVIRONMENTAL PROTECTION AND ENERGY

This certification is subject to unannounced laboratory inspections as specified by  
N.J.A.C. 7:18-2.11(d) and agreed to by the Laboratory Manager on filing the application  
TO BE CONSPICUOUSLY DISPLAYED AT THE LABORATORY WITH THE ANNUAL CERTIFIED PARAMETER LIST.

R2-0000209

STATE OF NEW JERSEY  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
OFFICE OF QUALITY ASSURANCE  
ANNUAL CERTIFIED PARAMETER LIST FOR 1994-1995

IMPUCHEM ENVIRONMENTAL CORP. (67249) IS CERTIFIED TO PERFORM THE ANALYSES  
BELOW UNTIL JUNE 30 1995.

WATER POLLUTION LABORATORY CERTIFICATION

LIMITED CHEMISTRY

00556 OIL AND GREASE  
00615 NITRITE  
00630 NITRATE  
00680 ORGANIC CARBON, TOTAL  
00720 CYANIDE, TOTAL  
00722 CYANIDE, AMEN TO CHLOR  
00940 CHLORIDE  
00945 SULFATE  
Q0951 FLUORIDE, TOTAL  
01032 CR HEX  
32730 PHENOLS

METALS

00915 CALCIUM (ICAP)  
00925 MAGNESIUM (ICAP)  
00929 SODIUM (ICAP)  
01000 ARSENIC (ICAP)

**WATER POLLUTION LABORATORY CERTIFICATION**

**ORGANICS**

**625 B/N, ACIDS & PEST (GC/MS)**

**99007 PESTICIDES**

**39330 ALDRIN**

**39380 DIELDRIN**

**39360 DDD**

**39365 DDE**

**39370DDT**

**39410 HEPTACHLOR**

**39350 CHLORDANE**

**THIS LIST MUST BE CONSPICUOUSLY DISPLAYED WITH THE PERMANENT  
CERTIFICATE AT THE LABORATORY**



**Attachment C3**

1.0 VOLATILES TARGET COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS

Volatiles	CAS Number	Quantitation Limits			
		Water	Lcw	Med.	On
		ug/L	Soil ug/Kg	Soil ug/Kg	Column (ng)
1. Chloromethane	74-87-3	10	10	1200	(50)
2. Bromomethane	74-83-9	10	10	1200	(50)
3. Vinyl Chloride	75-01-4	10	10	1200	(50)
4. Chloroethane	75-00-3	10	10	1200	(50)
5. Methylene Chloride	75-09-2	10	10	1200	(50)
6. Acetone	67-64-1	10	10	1200	(50)
7. Carbon Disulfide	75-15-0	10	10	1200	(50)
8. 1,1-Dichloroethene	75-35-4	10	10	1200	(50)
9. 1,1-Dichloroethane	75-34-3	10	10	1200	(50)
10. 1,2-Dichloroethene (total)	540-59-0	10	10	1200	(50)
11. Chloroform	67-66-3	10	10	1200	(50)
12. 1,2-Dichloroethane	107-06-2	10	10	1200	(50)
13. 2-Butanone	78-93-3	10	10	1200	(50)
14. 1,1,1-Trichloroethane	71-55-6	10	10	1200	(50)
15. Carbon Tetrachloride	56-23-5	10	10	1200	(50)
16. Bromodichloromethane	75-27-4	10	10	1200	(50)
17. 1,2-Dichloropropane	78-87-5	10	10	1200	(50)
18. cis-1,3-Dichloropropene	10061-01-5	10	10	1200	(50)
19. Trichloroethene	79-01-6	10	10	1200	(50)
20. Dibromochloromethane	124-48-1	10	10	1200	(50)
21. 1,1,2-Trichloroethane	79-00-5	10	10	1200	(50)
22. Benzene	71-43-2	10	10	1200	(50)
23. trans-1,3-Dichloropropene	10061-02-6	10	10	1200	(50)
24. Bromoform	75-25-2	10	10	1200	(50)
25. 4-Methyl-2-pentanone	108-10-1	10	10	1200	(50)
26. 2-Hexanone	591-78-6	10	10	1200	(50)
27. Tetrachloroethene	127-18-4	10	10	1200	(50)
28. 1,1,2,2-Tetrachloroethane	79-34-5	10	10	1200	(50)
29. Toluene	108-88-3	10	10	1200	(50)
30. Chlorobenzene	108-90-7	10	10	1200	(50)
31. Ethylbenzene	100-41-4	10	10	1200	(50)
32. Styrene	100-42-5	10	10	1200	(50)
33. Xylenes (total)	1330-20-7	10	10	1200	(50)

Exhibit C -- Section 2  
Semivolatiles (SVOA)

2.0 SEMIVOLATILES TARGET COMPOUND LIST AND CONTRACT REQUIRED QUANTITATION LIMITS

Semivolatiles	CAS Number	Quantitation Limits			
		Water	Low	Med.	On
		ug/L	Soil	Soil	Column
			ug/Kg	ug/Kg	(ng)
34. Phenol	108-95-2	10	330	10000	(20)
35. bis-(2-Chloroethyl) ether	111-44-4	10	330	10000	(20)
36. 2-Chlorophenol	95-57-8	10	330	10000	(20)
37. 1,3-Dichlorobenzene	541-73-1	10	330	10000	(20)
38. 1,4-Dichlorobenzene	106-46-7	10	330	10000	(20)
39. 1,2-Dichlorobenzene	95-50-1	10	330	10000	(20)
40. 2-Methylphenol	95-48-7	10	330	10000	(20)
41. 2,2'-oxybis (1-Chloropropane) <sup>1</sup>	108-60-1	10	330	10000	(20)
42. 4-Methylphenol	106-44-5	10	330	10000	(20)
43. N-Nitroso-di-n-propylamine	621-64-7	10	330	10000	(20)
44. Hexachloroethane	67-72-1	10	330	10000	(20)
45. Nitrobenzene	98-95-3	10	330	10000	(20)
46. Isophorone	78-59-1	10	330	10000	(20)
47. 2-Nitrophenol	88-75-5	10	330	10000	(20)
48. 2,4-Dimethylphenol	105-67-9	10	330	10000	(20)
49. bis(2-Chloroethoxy) methane	111-91-1	10	330	10000	(20)
50. 2,4-Dichlorophenol	120-83-2	10	330	10000	(20)
51. 1,2,4-Trichlorobenzene	120-82-1	10	330	10000	(20)
52. Naphthalene	91-20-3	10	330	10000	(20)
53. 4-Chloroaniline	106-47-8	10	330	10000	(20)
54. Hexachlorobutadiene	87-68-3	10	330	10000	(20)
55. 4-Chloro-3-methylphenol	59-50-7	10	330	10000	(20)
56. 2-Methylnaphthalene	91-57-6	10	330	10000	(20)
57. Hexachlorocyclopentadiene	77-47-4	10	330	10000	(20)
58. 2,4,6-Trichlorophenol	88-06-2	10	330	10000	(20)
59. 2,4,5-Trichlorophenol	95-95-4	25	830	25000	(50)
60. 2-Chloronaphthalene	91-58-7	10	330	10000	(20)
61. 2-Nitroaniline	88-74-4	25	830	25000	(50)

<sup>1</sup>Previously known by the name bis(2-Chloroisopropyl) ether.

Exhibit C -- Section 2  
Semivolatiles (SVOA)

Semivolatiles	CAS Number	Quantitation Limits			
		Water	Low Soil	Med. Soil	On Column
		ug/L	ug/Kg	ug/Kg	(ng)
62. Dimethylphthalate	131-11-3	10	330	10000	(20)
63. Acenaphthylene	208-96-8	10	330	10000	(20)
64. 2,6-Dinitrotoluene	606-20-2	10	330	10000	(20)
65. 3-Nitroaniline	99-09-2	25	830	25000	(50)
66. Acenaphthene	83-32-9	10	330	10000	(20)
67. 2,4-Dinitrophenol	51-28-5	25	830	25000	(50)
68. 4-Nitrophenol	100-02-7	25	830	25000	(50)
69. Dibenzofuran	132-64-9	10	330	10000	(20)
70. 2,4-Dinitrotoluene	121-14-2	10	330	10000	(20)
71. Diethylphthalate	84-66-2	10	330	10000	(20)
72. 4-Chlorophenyl-phenyl ether	7005-72-3	10	330	10000	(20)
73. Fluorene	86-73-7	10	330	10000	(20)
74. 4-Nitroaniline	100-01-6	25	830	25000	(50)
75. 4,6-Dinitro-2-methylphenol	534-52-1	25	830	25000	(50)
76. N-Nitroso-diphenylamine	86-30-6	10	330	10000	(20)
77. 4-Bromophenyl-phenylether	101-55-3	10	330	10000	(20)
78. Hexachlorobenzene	118-74-1	10	330	10000	(20)
79. Pentachlorophenol	87-86-5	25	830	25000	(50)
80. Phenanthrene	85-01-8	10	330	10000	(20)
81. Anthracene	120-12-7	10	330	10000	(20)
82. Carbazole	86-74-8	10	330	10000	(20)
83. Di-n-butylphthalate	84-74-2	10	330	10000	(20)
84. Fluoranthene	206-44-0	10	330	10000	(20)
85. Pyrene	129-00-0	10	330	10000	(20)
86. Butylbenzylphthalate	85-68-7	10	330	10000	(20)
87. 3,3'-Dichlorobenzidine	91-94-1	10	330	10000	(20)
88. Benzo(a)anthracene	56-55-3	10	330	10000	(20)
89. Chrysene	218-01-9	10	330	10000	(20)
90. bis(2-Ethylhexyl)phthalate	117-81-7	10	330	10000	(20)
91. Di-n-octylphthalate	117-84-0	10	330	10000	(20)
92. Benzo(b)fluoranthene	205-99-2	10	330	10000	(20)
93. Benzo(k)fluoranthene	207-08-9	10	330	10000	(20)

Exhibit C -- Section 2  
Semivolatiles (SVOA)

Semivolatiles	CAS Number	Quantitation Limits			
		Water	Low Soil	Med. Soil	On Column
		ug/L	ug/Kg	ug/Kg	(ng)
94. Benzo(a)pyrene	50-32-8	10	330	10000	(20)
95. Indeno(1,2,3-cd)-pyrene	193-39-5	10	330	10000	(20)
96. Dibenzo(a,h)-anthracene	53-70-3	10	330	10000	(20)
97. Benzo(g,h,i)perylene	191-24-2	10	330	10000	(20)

Exhibit C -- Section 3  
Pesticides/Aroclors (PEST/ARO)

3.0 PESTICIDES/AROCLORS TARGET COMPOUND LIST AND CONTRACT REQUIRED  
QUANTITATION LIMITS<sup>2,3</sup>

Pesticides/Aroclors	CAS Number	Quantitation Limits		
		Water	Soil	On Column
		ug/L	ug/Kg	(pg)
98. alpha-BHC	319-84-6	0.050	1.7	5
99. beta-BHC	319-85-7	0.050	1.7	5
100. delta-BHC	319-86-8	0.050	1.7	5
101. gamma-BHC (Lindane)	58-89-9	0.050	1.7	5
102. Heptachlor	76-44-8	0.050	1.7	5
103. Aldrin	309-00-2	0.050	1.7	5
104. Heptachlor epoxide <sup>4</sup>	111024-57-3	0.050	1.7	5
105. Endosulfan I	959-98-8	0.050	1.7	5
106. Dieldrin	60-57-1	0.10	3.3	10
107. 4,4'-DDE	72-55-9	0.10	3.3	10
108. Endrin	72-20-8	0.10	3.3	10
109. Endosulfan II	33213-65-9	0.10	3.3	10
110. 4,4'-DDD	72-54-8	0.10	3.3	10
111. Endosulfan sulfate	1031-07-8	0.10	3.3	10
112. 4,4'-DDT	50-29-3	0.10	3.3	10
113. Methoxychlor	72-43-5	0.50	17	50
114. Endrin ketone	53494-70-5	0.10	3.3	10
115. Endrin aldehyde	7421-93-4	0.10	3.3	10
116. alpha-Chlordane	5103-71-9	0.050	1.7	5
117. gamma-Chlordane	5103-74-2	0.050	1.7	5
118. Toxaphene	8001-35-2	5.0	170	500
119. Aroclor-1016	12674-11-2	1.0	33	100
120. Aroclor-1221	11104-28-2	2.0	67	200
121. Aroclor-1232	11141-16-5	1.0	33	100
122. Aroclor-1242	53469-21-9	1.0	33	100
123. Aroclor-1248	12672-29-6	1.0	33	100
124. Aroclor-1254	11097-69-1	1.0	33	100
125. Aroclor-1260	11096-82-5	1.0	33	100

<sup>2</sup>There is no differentiation between the preparation of low and medium soil samples in this method for the analysis of pesticides/Aroclors.

<sup>3</sup>The lower reporting limit for pesticide instrument blanks shall be one-half the CRQL values for water samples.

<sup>4</sup>Only the exo-epoxy isomer (isomer B) of heptachlor epoxide is reported on the data reporting forms (Exhibit B).

**INORGANIC TARGET ANALYTE LIST (TAL)**

Analyte	Contract Required Detection Limit (1,2) (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10

- (1) Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the Contract Required Detection Limit. This is illustrated in the example below:

For lead:

Method in use - ICP

Instrument Detection Limit (IDL) - 40

Sample concentration - 220

Contract Required Detection Limit (CRDL) - 3



**APPENDIX D**  
**Health and Safety Plan**

**APPENDIX D**

**HEALTH AND SAFETY PLAN  
FOR OFF-PROPERTY INVESTIGATION  
216 PATERSON PLANK ROAD SITE  
CARLSTADT, NEW JERSEY**

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## **1.0 GENERAL INFORMATION AND SCOPE OF WORK**

### **1.1 Project Description**

This Health and Safety Plan (HASP) has been prepared by Golder Associates Inc. (Golder Associates) as part of the Work Plan Amendment (Work Plan) to perform an additional Off-Property Investigation (Investigation) at the 216 Paterson Plank Road Site (Site) in Carlstadt, Bergen County, New Jersey. This plan was prepared in accordance with "Guidance for Conducting Remedial Investigations and Feasibility Studies (RI/FS) under CERCLA" and the NIOSH/OSHA/USCG/EPA "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" as well as 29 CFR 1910.120, 29 CFR 1926 and applicable Federal and state regulations and guidelines. This plan supersedes any previous Health and Safety Plans prepared for the Investigation. It will be reviewed as appropriate when field and/or laboratory data becomes available and amended to ensure that the proper level(s) of protection are maintained.

This plan covers field activities including drilling and rock coring, well/piezometer installation, hydrogeologic and geophysical testing, and groundwater sampling.

### **1.2 Site Background**

The 6-acre Site is a former chemical recycling and waste processing facility which ceased operation in 1980 and is located in a light industrial/commercial area of Carlstadt, New Jersey (Figure B1 in the SAMP). The property is bordered to the southwest by Paterson Plank Road, to the northwest by Gotham Parkway, to the southeast by a trucking company, and to the northeast by Peach Island Creek. The Site was placed on USEPA's National Priorities List (NPL) in 1983.

Previous investigations on the Site have determined that soils and groundwater are contaminated with volatiles and semi-volatile compounds, pesticides, PCBs, and inorganic compounds.

Work on this project will take place at locations primarily outside the 216 Paterson Plank Road property and adjacent to the public rights-of-way which surround the property. Intrusive activities in all areas will require compliance with 29 CFR 1910.120 and additional precautions may be necessary due to the public's proximity to these areas. Unauthorized persons entering work areas will be asked to immediately leave. Should they ignore this request, Carlstadt Police will be notified and asked to come to the Site.

### **1.3 Project Safety Requirements**

The level of protection and the procedures specified in this HASP are based on the information currently available and represent the minimum health and safety requirements to be observed by all Site personnel engaged in the Investigations. Unknown conditions at the Site and off-property locations may exist and known conditions may change. Should any situation arise which is beyond the scope of the personal protection and decontamination procedures specified herein, work activities shall be immediately halted pending discussion with the Health and Safety Officer (HSO) and Project Manager, and revision of the specified health and safety procedures. Any revision of the health and safety procedures will be recorded in the Field Procedure Change Authorization Form, shown in Attachment D1, and will require authorization from the Health and Safety Officer and the Project Manager.

All Site personnel engaged in project activities must read this document carefully and complete the Safety Briefing Form in Attachment D2. Personnel who have any questions or concerns regarding implementation of this plan are encouraged to request clarification from the Health and Safety Officer or on-site Health and Safety Coordinator. All personnel must follow the designated health and safety procedures, be alert to the hazards associated with working close to vehicles and equipment, and above all else, use common sense and exercise reasonable caution at all times.

#### **1.3.1 Designated Safety Personnel and Chain of Command**

Personnel responsible for implementing this HASP include the following:

**Golder Associates**

Stuart D. Mitchell, P.G.	Golder Site Health and Safety Coordinator
Charles Roberts	Health and Safety Officer
Robert J. Illes, P.G.	Project Manager

Each subcontractor will have a designated Site Health and Safety Coordinator. Health and Safety Coordinators are responsible for assuring that the designated procedures are implemented in the field. The Golder Associates Site Health and Safety Coordinator is responsible for coordinating site safety activities.

The Health and Safety Officer has overall responsibility for establishing appropriate health and safety procedures for the project and will have the requisite authority to implement those procedures including, if necessary, the authority to temporarily shut the project down for health and safety reasons.

The Project Manager also has the authority to take whatever actions may be necessary, based on the advice and direction of the Health and Safety Officer, to provide a safe working environment for all project personnel.

The ultimate responsibility for the health and safety of the individual employee rests with the employee, and his or her colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her own health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel as designated above, and to follow-up the verbal notification by completing the "Unsafe Conditions and Practices" report form provided in Attachment D3.

Should an employee find himself or herself in a potentially hazardous situation, the employee shall immediately discontinue the hazardous procedure(s) and either personally



effect appropriate preventative or corrective measures, or immediately notify the Site Health and Safety Coordinator or Project Manager of the nature of the hazard. In the event of an immediately dangerous or life threatening situation, the employee always has "stop work" authority.

Unsafe work practices or procedures are never justified by "extenuating circumstances" such as budget or time constraints, equipment breakdown, changing or unexpected conditions, etc.. In fact, the opposite is true. Under stressful circumstances all project personnel must be mindful of the potential to consciously or unconsciously compromise health and safety standards, and be especially safety conscious. All Site personnel are required to consider "safety first" at all times.

### **1.3.2 Medical Surveillance and Training**

All personnel engaged in field activities on this project must have baseline physical examinations and be participants in their employer's medical surveillance program. This program must meet, at a minimum, the requirements of 29 CFR 1910.120(f). Procedures beyond baseline physical and routine medical surveillance are not planned for the tasks listed in this HASP.

All project personnel, who have potential to contact contaminated soil, water, and/or air, must be trained in hazardous waste site investigation health and safety in accordance with 29 CFR 1910.120(e) including respiratory protection, personal protective clothing, decontamination, hazard recognition and the proper calibration and use of the combustible gas indicator (CGI), photoionization detector (PID), and colorimetric detector tubes. Personnel must have appropriate refresher courses as detailed in 29 CFR 1910.120(e). Supervisory personnel will have completed the supervisor training requirement detailed in 29 CFR 1910.120(e).

Personnel who operate specialized equipment (e.g., drill rigs, forklifts) shall be trained by their employer(s) to operate such equipment.

These training requirements apply to all employees unless the employer can demonstrate that the operation does not involve employee exposure, or the reasonable possibility for employee exposure, to safety and health hazards. Some non-intrusive activities (e.g. supply delivery, limited surveying activities) may meet this exemption. In that site conditions are subject to change, the training requirements for non-intrusive activities will be reviewed on a case-by-case basis. The Site Health and Safety Coordinator will make the determination on the case by case basis and will consult the Health and Safety Officer as necessary.

### **1.3.3 First Aid**

A first aid kit shall be available in all field vehicles and in the on-site trailer during all site activities. This kit shall be of an appropriate size in relation to the number of personnel on site and shall include at a minimum two pairs of latex gloves, CPR barrier and eye wash solution, in addition to first aid supplies (e.g., bandages, first aid cream, antiseptic).

### **1.3.4 Communications**

There will be an on-site trailer equipped with a phone. In addition, a mobile phone will be located in a designated field vehicle. Note that mobile phones operating outside of their original territory may not contact the proper (i.e. local) emergency response authorities. Mobile phone users would be better served by dialing the full emergency response number.

Additionally, if field operations require that two or more field teams work at the Site, but beyond visual/aural range two-way radios may be necessary to maintain communications.

The protective equipment requirements for some tasks may necessitate the use of respiratory protection which could adversely affect communications. In such instances, the field team will review basic hand signal communications during a safety briefing prior to donning respiratory protection equipment.

---

#### 1.4 General Hygiene and Conduct Guidelines

The following general personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. These guidelines represent the minimum standard procedures for reducing potential risks associated with various aspects of this project and are to be followed by all Site personnel at all times.

- A multi-purpose dry chemical fire extinguisher, a complete field first aid kit, and a bottle of emergency eye wash solution shall be maintained in every field vehicle. Additionally, Site trailers will also be equipped with these emergency items.
- Do not handle waste samples or any other potentially contaminated items unless wearing NBR (nitrile butadiene rubber) or neoprene rubber gloves, or equivalent, as a minimum. Employees should treat all soil and water as if it were contaminated. Always make an effort to approach any potentially contaminated feature/facility from upwind.
- Thoroughly wash hands and face before eating or putting anything in your mouth (i.e., avoid hand to mouth contamination).
- Eating, drinking, chewing gum or tobacco and smoking are permitted only in areas designated by the Site Health and Safety Coordinator. Under no circumstances will these activities be permitted in the immediate vicinity of any intrusive activities (e.g., drilling).
- Be alert to potentially changing exposure conditions, for example, as evidenced by perceptible odors or oily sheen on water.
- Do not, under any circumstances, enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying human passengers.
- Be alert to the symptoms of fatigue and heat/cold stress, and their affects on the normal caution and judgment of personnel.
- Noise may pose a health and safety hazard, particularly during drilling and construction activities. A good rule of thumb is if it is necessary to shout to communicate at a distance of three feet in steady state (continuous) noise, hearing protection should be worn. Likewise, any impact noises from activities (e.g., driving casing on a drilling operation) which is loud enough to cause discomfort, would also indicate the need for hearing

protection. Hearing protection is available and is included in the standard field kit along with hard hat and safety glasses.

- Always use an appropriate level of personal protection. Reduced levels of protection can result in preventable exposure; excessive levels of safety equipment can impair efficiency and increase the potential for accidents to occur.
- Be aware of the effect of inclement weather (rain, snow, ice, lightning) has on Site safety. Be prepared to suspend activities as conditions warrant.
- Extreme caution must be used when drilling or other activities occur near overhead utility lines. The National Drilling Federation recommends a minimum distance of 20 feet between the lines and drill rig. Contact the local power company if you have any questions regarding utility line status or voltage. In addition, underground utilities must be positively located and marked prior to intrusive activities.
- All personnel are required to wear orange colored vests when working in the proximity of public rights-of-way and/or parking areas. Additionally, traffic cones and other warning devices may be required if the public rights-of-way are obstructed.

### **1.5 Site Safety Meetings**

Site Health and Safety Coordinators shall conduct a Site safety briefing for all personnel on their initial arrival at Site. All personnel will be required to read the Health & Safety Plan and will be required to sign the declaration in Attachment D2 before conducting any work on-site.

Site Health and Safety Coordinators or his/her designee shall conduct and document daily safety meetings. The topics to be covered are determined by the task activities, and should include:

- Weather and traffic related safety issues.
- Hazards specific to the task(s) and protective equipment.
- Unusual site conditions/areas.
- Safety problems and issues.
- Changes in the HASP.

The date, time, content and attendees of each meeting shall be documented.

## **1.6 Acronyms and Definitions**

Terms used in the HASP, are as follows:

ACGIH - American Conference of Governmental Industrial Hygienists

Authorized Personnel - Any person, including task-specific personnel, project personnel, oversight personnel, contractors and consultants whose presence is authorized.

Breathing Zone - The worker's breathing zone is an imaginary zone of two foot radius surrounding the head.

Contamination-Reduction Zone - The area designated for removal of contaminants from personnel and equipment. This area is adjacent to the Exclusion Zone.

Contractor/Consultant - Any person or firm, retained or hired by the 216 Paterson Plan Road Cooperating PRP Group and/or their contractors, to carry out and/or supervise any portion of the activities conducted at the Site.

Exclusion Zone - The area to which all personnel entering must be directly involved in the ongoing work, have designated personal protective equipment (PPE), and meet training and medical monitoring requirements. The Exclusion Zone will be defined by an approximate 25-foot radius around the work area, which will be suitably marked.

HASP - Health and Safety Plan

HSO - Health and Safety Officer

IDLH - Immediate Danger to Life and Health

MSDS - Material Safety Data Sheets, which provide information on the physical, chemical, and hazardous properties of chemical compounds.

NIOSH - National Institute of Occupational Safety and Health

On-Property - The 216 Paterson Plank Road facility actively controlled by the Cooperating PRP Group.

Off-Property - Areas not owned and/or controlled by the Cooperating PRP Group.

**OSHA** - Occupational Safety and Health Administration

**Oversight Personnel** - Any person, designated by the state or federal government, who is assigned to carry out oversight work.

**PEL** - Permissible Exposure Limit

**PPE** - Personal Protective Equipment

**PPM** - Parts per million; expressed as ppm(v) for gases and vapors.

**Potential Source Area** - The areas designated by the USEPA as areas of potential contamination and, if necessary, posted by signs with "Authorized Trained Personnel Only".

**REL** - Recommended Exposure Limit

**SAMP** - Sampling Analysis and Monitoring Plan

**Site** - The 216 Paterson Plank Road Superfund Site

**Support Zone** - The area outside the Exclusion Zone that is considered clean for the purpose of the HASP. It is used for transfer of equipment and materials into the work site (i.e., support) and providing communications between the various zones.

**TLV** - Threshold Limit Value

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## **2.0 HAZARD EVALUATION**

Potential Site hazards include chemical hazards, physical hazards, and biological hazards. Each of these groups of potential hazards is addressed below.

### **2.1 Potential Chemical Hazards**

Results of past sampling activities at the Site indicate that there has been chemical contamination of the soil and groundwater. Table D1 summarizes the potentially hazardous chemicals of concern found on Site in the previous Remedial Investigation activities. Table D2 summarizes airborne exposure limits for these chemical contaminants. The chemical hazard associated with the reported chemical concentrations in the groundwater and soil is toxicity. Potential hazards include:

- (1) Inhalation of organic vapors due to the presence of volatile organic compounds (VOCs) in the soil and groundwater.
- (2) Inadvertent ingestion of potentially toxic substances via hand to mouth contact or deliberate ingestion of materials inadvertently contaminated with potentially toxic materials. Included in this list are VOCs, semi-volatiles, pesticides, PCBs and inorganic compounds.
- (3) Dermal exposure and possible percutaneous (skin) absorption of certain lipophilic (readily absorbed through the skin) organic chemicals including benzene.

Exposure via the ingestion route can be controlled effectively by the means of good personal hygiene habits, and prohibition of smoking, eating, drinking and chewing in contaminated areas. Similarly, dermal exposure can be eliminated by good personal hygiene and appropriate clothing. Inhalation hazards are addressed in Section 4.3 below.

### **2.2 Potential Physical Hazards**

#### **2.2.1 Heat Stress**

Working in protective clothing can greatly increase the likelihood of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious

illness or death. The signs and symptoms of heat stress are presented in Section 2.4. Workers shall monitor themselves and others for signs of heat stress when ambient temperatures exceed 80 degrees Fahrenheit (70 degrees when wearing Tyvek coveralls).

### **2.2.2 Cold Stress**

Personnel exposed to cold temperatures (especially during windy conditions) may be subjected to cold stress in the form of frost nip, frost bite or hypothermia. Signs and symptoms of cold stress are described in Section 2.4. Workers shall monitor themselves and others for signs of frost nip when cold weather occurs. Extra caution will be exercised when working in windy conditions and/or when clothing becomes wet.

### **2.2.3 Confined Space/Test Pit Hazards**

No confined space work is anticipated. Should such work become necessary, a Confined Space Entry Permit will be completed and an addendum to this HASP will be prepared.

### **2.2.4 Other Physical Hazards**

All Site employees must take note of physical hazards which are identified during site safety briefings. These hazards include, but are not limited to: steep slopes, soft sediments, muck, and the creek (trips, falls, and drowning); sharp debris (puncture wound); overhead utilities, public traffic and slippery and/or congested walking surfaces (falls). Orange vests will be worn when working near public rights-of-way. Work areas such as borings must be delineated using high visibility caution tape.

During drilling activities no more than two lengths of drill rod may extend above the top of the rig derrick at any time.

Field personnel must be alert to the hazards associated with site vehicles, drill rig operation, heavy equipment, and powered hand-held equipment operations. These hazards include noise, crushing injuries, overhead hazards, and pinch points. Personnel must be alert to weather-



related hazards (e.g., lightning) or the possibility of increased hazard due to weather (e.g., slipping on mud or ice).

### **2.3 Potential Biological Hazards**

Contact with waste materials can lead to infected cuts. Personnel shall follow the guidelines in Section 1.4 and follow first aid procedures for disinfection of cuts and abrasions.

The Site area may contain ticks which can transmit Rocky Mountain Spotted Fever and Lyme Disease. During tick season (March to November), Site employees will check for ticks. Light colored clothing should be worn and any openings (shirt and pant cuffs) should be secured to inhibit tick movement from clothing to skin. The use of insect repellents should be considered if its use will not interfere with sampling activities. Personnel must check with their Project Manager before using repellents. Field personnel will acquaint themselves with the symptoms of tick-borne diseases detailed below and will contact a physician as well as the Health and Safety Officer if a disease is suspected.

The Site area may also harbor potentially harmful snakes. Personnel must be alert to these reptiles.

The Site area may contain poison ivy which can be recognized by an oily sheen on the leaf and/or three leaflets together or similar vegetation. The active substances can be transmitted by direct skin contact and via contact with contaminated clothing.

### **2.4 Signs and Symptoms of Exposure**

#### **2.4.1 Chemical Exposure**

The health effects associated with the chemical contaminants at the site are varied. Personnel who experience any of the following symptoms should report the occurrence to the Health and Safety Coordinator promptly:

- skin, eye, or respiratory system irritations;
- skin rashes/burns;
- headaches, dizziness;
- nausea/GI tract problems;
- muscle spasms/tremors;
- chills; and/or
- fatigue.

Note that the above symptoms are not necessarily caused by chemical exposure. Any serious medical problem should be promptly referred to professional medical care. If personnel experience any of the above symptoms, the Health and Safety Coordinator shall evacuate the area (upwind if possible) if necessary and evaluate affected personnel for signs and symptoms of exposure. Appropriate first aid measures shall be taken. The activity will not resume until the atmospheric conditions are evaluated using monitoring instruments by personnel wearing Level C (or B, if Level C was utilized when the incident occurred) Personal Protective Equipment. Atmospheric conditions will be evaluated by monitoring for concentrations of combustible gases, VOCs, H<sub>2</sub>S, and HCN as described in Section 3.

#### **2.4.2 Physical Exposure**

The signs of heat stress are as follows:

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
  - muscle spasms; and
  - pain in hands, feet, and abdomen.

Heat exhaustion from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include:

- pale, cool, moist skin;
- heavy sweating;
- dizziness;
- nausea; and

- fainting.

Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:

- red, hot, usually dry skin;
- lack of or reduced perspiration;
- nausea;
- dizziness and confusion;
- strong, rapid pulse; and
- coma.

Working in protective clothing can greatly increase the likelihood of heat fatigue, heat exhaustion, and heat stroke, the latter being a life threatening condition. When working in ambient temperatures greater than 80°F (70°F when in Level B equipment), employees shall use the 'buddy system' to monitor each other's pulse rate at the start of each rest period. A rest period shall consist of a continuous time period of at least five (5) minutes preferably in a shaded area. The personnel will not be assigned to other work during this rest period. If the pulse rate exceeds 110 beats per minute, the employee shall take his or her oral temperature with a clean disposable calorimetric oral thermometer. If the oral temperature exceeds 99.6°F, the next work period shall be shortened by one third. The pulse rate and oral temperature shall be monitored again at the beginning of the next rest period; and if the oral temperature exceeds 99.6°F, the work period shall again be shortened by one third, etc., until the oral temperature is below 99.6°F.

All employees are to be alert to the possibility and symptoms of heat stress. If heat stress is suspected the employee will leave the work area, rest, cool off, and drink plenty of cool water/Gatorade/Squelcher or equivalent. Sufficient cool potable water and clean disposable cups shall be maintained at all times on-site. If the symptoms do not subside after a reasonable rest period, the employee shall notify the on-site Health and Safety Coordinator and seek medical assistance.

Signs of cold stress include yellow or white patches of skin on the fingertips, nose and ears. These areas will be numb. The affected parts will be rewarmed gently and the patient will not return to work until additional protection (e.g., gloves, hard hat liner) is obtained. It is essential to prevent frost bite as the person may become susceptible to future cold-related medical problems. Personnel are encouraged to change into dry socks after the lunch break as perspiration held by the socks prompts cooling of the feet. Should clothing become wet, it is imperative that the person change into dry clothes before resuming work. Wet clothing can lead to hypothermia. Symptoms of hypothermia include uncontrollable shivering, decreased physical and mental capabilities, and lowered body temperature. Persons exhibiting symptoms of cold stress or hypothermia will not return to work without the approval of the site Health and Safety Coordinator.

#### **2.4.3 Biological Exposure**

Symptoms of Rocky Mountain Spotted Fever include fever chills, headache, abdominal, muscle pain, and nausea. A red rash develops at the wrist and ankles two to five days after exposure. Symptoms develop two to fourteen days after exposure.

Symptoms of Lyme Disease include fatigue, stiffness (particularly in the neck). There may be a red circular rash. Fever may be present. Symptoms develop a few days to two years after exposure.

Personnel exhibiting symptoms of Rocky Mountain Spotted Fever or Lyme Disease should consult a medical professional immediately.

Personnel bitten by a snake will immediately clean the wound and proceed to the hospital for medical evaluation.

Skin-sensitizing (poisonous) vegetation produces a bumpy, swollen rash at the point of contact. This rash is easily spread if the oil gets on the fingers. Wash affected area(s)

including tools, as soon as possible. Use over-the-counter medications to reduce the irritation. Avoid scratching the rash. Cover the affected area(s) with clean dressings. Severe exposure may necessitate evaluation by a medical professional.

## **2.5 Task Risk Analysis**

Table D3 presents a comparative risk analysis based on anticipated field activities and hazards. All personnel will be aware that specific hazards and the associated potential severity may be influenced by weather, season, and fatigue.

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### 3.0 SITE MONITORING AND ACTION LEVELS

Air monitoring is required during intrusive tasks. The requirements for air monitoring and associated action levels for each site activity are detailed in Table D4. The monitoring methods involved and their interpretation are discussed in the following sections. Intrusive activities have the potential for exposures to VOCs and a slight possibility of explosive concentrations of various gases.

Past air monitoring conducted on-site has indicated that no VOC concentrations approached the Action Level for the particular chemicals. All observed concentrations were less than the 8-hour ACGIH TLV inhalation standards for the VOCs detected at the Site. Routine air monitoring is therefore not required during non-intrusive activities.

#### 3.1 Combustible Gases

Chemical waste sites may contain explosive concentrations of non-methane gases. Underground utility lines could be damaged or weakened such that explosive gases are released. Digging or drilling (including hand augering) into such an area can pose a fire and explosion hazard.

An MSA Model 361 oxygen, combustible gas, and hydrogen sulfide detector, or an equivalent direct reading instrument, will be used to monitor combustible gas concentrations during appropriate tasks as defined in Table D4. The instrument calibration must be checked daily. The MSA 361 is factory calibrated to pentane.

The LEL concentration (the lowest concentration at which a gas becomes explosive in air) is typically between 1 percent and 7 percent for most "combustible" organic vapors and gases. This corresponds to a concentration of 10,000 to 70,000 parts per million (ppm) by volume in air. The LEL concentration of methane for example is 5% or 50,000 ppm in air. Consequently, 50% LEL of methane is equivalent to 25,000 ppm. At such

concentrations most flammable gases can be detected by the sense of smell. However, methane and hydrogen are notable exceptions.

During drilling operations, the MSA 361 probe shall be lowered into the borehole or casing whenever it is convenient, but at least at five foot drilling intervals or once per hour, whichever is more frequent. Both combustible gas concentrations and oxygen concentrations will be determined in the borehole, at the borehole mouth and in the workers' breathing zone. Do not lower the probe into water. Use the in-line water trap when working around liquids.

No open flames, matches, cigarette lighters, or fires of any kind shall be allowed in the vicinity of the drilling operations. If the elevated levels are due to a localized pocket of gas, levels may drop and drilling can proceed, with caution and vigilant monitoring. If levels increase, the hole may be purged with carbon dioxide gas (which is heavier than air), or solid CO<sub>2</sub> (dry ice). If subsequent combustible gas levels at the surface and combustible gas/oxygen levels at depth no longer indicate the presence of an explosion hazard, work may continue with frequent monitoring and extreme caution. If explosive gas levels exceed 20% LEL beyond the mouth of the hole, work should be halted pending discussion with health and safety personnel.

Combustible gas levels must always be determined prior to any welding on casing or in the vicinity of the borehole. Readings should be taken at depth, at the mouth of the casing, and around the outside of the casing at ground level. Readings in excess of 20% LEL indicate the need for an inflatable bladder to isolate the borehole atmosphere from any potential ignition sources. The bladder is inserted into the well casing below the weld, inflated, and covered with water to ensure a gas-tight fit. When welding is completed, the bladder is deflated and removed. Should explosive gas in excess of 20% LEL be detected in the casing annulus, work will temporarily cease, ignition sources will be secured and the Project Manager will be contacted. If the condition does not subside, engineering controls

will be established. These controls will be situation dependent and will be tested for effectiveness before welding occurs.

It may not be appropriate to designate a single "cease operations" action level for combustible gases encountered during drilling operations. The Site Health and Safety Coordinator must be sufficiently knowledgeable to assess the situation taking into account all of the factors discussed above. As a general rule, however, any readings greater than 20% LEL at depth are cause for increased monitoring activity. Readings greater than 50% LEL in the presence of oxygen concentrations greater than 12 percent require extreme caution, increased vigilance, and a careful assessment of overall conditions as discussed above. In the presence of combustible gas levels greater than 20% LEL a foot or so above the mouth of the hole or casing, the Site Health and Safety Coordinator should temporarily cease operations and carefully assess the situation. Conditions may call for preventative or corrective measures, such as purging the hole using carbon dioxide or general site ventilation.

### **3.2 Hydrogen Sulfide**

Hydrogen sulfide concentrations may be monitored on the MSA 361 directly in ppm, concurrently with combustible gas measurements. Calibration of the hydrogen sulfide detector must be checked prior to each day of use by introducing a 10 ppm (or 40 ppm) H<sub>2</sub>S calibration gas. Instrument readings should be 9-11 ppm or 36-44 ppm, respectively.

The eight hour time weighted average threshold limit value (TLV) for H<sub>2</sub>S is 10 ppm and the 15 minute short term exposure limit (STEL) is 15 ppm. The immediately dangerous to life and health (IDLH) level is 300 ppm.

If H<sub>2</sub>S concentrations greater than 10 ppm are detected at the mouth of the borehole, the monitoring frequency shall be increased and/or the MSA 361 can be set up to run continuously at the driller's operating position.



At concentrations of a few ppm in the breathing zone, the odor nuisance would be such that site personnel would probably voluntarily don air purifying respirators. Such use of air purifying respirators is appropriate if H<sub>2</sub>S concentrations are being monitored continuously.

If concentrations in the breathing zone exceed 10 ppm for more than an hour, 15 ppm for more than 15 minutes, or at any time exceed 25 ppm, work shall be temporarily halted until H<sub>2</sub>S levels subside, engineering controls are implemented or until Site personnel are equipped with pressure demand air supplying respirators. The Health and Safety Officer must be advised of such conditions and approve the revised procedures prior to implementation.

### 3.3 VOC Monitoring

Volatile organics that are of most concern from an inhalation standpoint are those that are moderately to highly toxic and have odor thresholds higher than their corresponding TLV. Tetrachloroethylene, benzene and trichloroethylene fall into this category.

The designated Site Health and Safety Coordinator shall have on-site at all times during intrusive activities a Photovac MicroTip II or equivalent. Calibration of the instrument must be checked daily prior to each day of use by introducing a known concentration of isobutylene gas in accordance with the manufacturer's instructions. Background levels must be established well upwind of any excavation, borehole, spoils pile, etc. The Health and Safety Coordinator shall monitor the borehole and employee breathing zone at least every 15 minutes, or whenever there is any indication that concentrations may have changed (odors, visible gases, appearance of drill cuttings, etc.) since the last measurement. If the exact nature of the contaminant(s) is unknown, any consistent readings >1 ppm in the breathing zone (above background level) for more than five minutes, or any readings in the breathing zone greater than 10 ppm above background level other than a momentary peak or any peak >25 ppm above background level shall be the action level for donning air purifying respirators equipped with HEPA/organic vapor

acid gas cartridges. The Health and Safety Officer must be advised of such conditions and approve the revised procedures. Prolonged concentrations above 25 ppm above background levels or numerous peaks will be evaluated by the Health and Safety Officer and Project Manager for upgrading to Level "B" respiratory protection.

Given the rapid "break through" time of some substances, cartridges will be replaced after each day of use or immediately upon an indication of "break through" (perceptible odors inside of the mask), whichever is less. High humidity situations (>80% relative humidity) may require cartridge replacement at a more frequent rate (every 4 hours).

Engineering controls such as additional ventilation may be used in place of respiratory protection if it is demonstrated through monitoring that the engineering controls are effective in reducing airborne concentrations.

### **3.4 Nuisance Dust, Pesticides, PCBs and Metals Monitoring**

Nuisance dust, pesticides, PCBs and metals have the potential for becoming a problem during disruptive or intrusive activities such as drilling. The specific metal concentrations are variable through the site. Activities that generate dust will require engineering controls (e.g., water misting of the air and surrounding soil) before and during the activities. Should engineering controls be ineffective as evidenced by chronic visible airborne dust, Level C respiratory protection will be utilized, real time aerosol monitoring using an MIE PDM-3 miniram or equivalent will be conducted and the airborne metal concentration will be estimated using prior worst case soil concentration data for metals. The MIE PDM-3 miniram is factory calibrated by the vendor prior to field use.

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#### **4.0 ON-SITE CONTROL**

##### **4.1 Site Communication System**

Personnel will operate using the "buddy system". Each individual shall maintain visual/aural contact with another individual or group at all times. If more than one group is working at the Site and the groups are not within visual/aural communication range, two-way radios may be necessary to maintain communications.

##### **4.2 Site Safety Zone and Access Control**

No on-site safety zones are required for non-intrusive activities. During intrusive activities (e.g. drilling), an Exclusion Zone will be established by the site personnel. The Exclusion Zone will generally be a 25 foot radius from the boreholes. Monitoring will be periodically conducted at the downwind perimeters to assure that the concentrations are similar to background concentrations. If perimeter concentrations are greater than background concentrations for more than five minutes, the downwind perimeter shall be extended, where practical, or engineering controls will be implemented such that downwind and background concentrations are similar. Exposed materials such as cuttings will be contained or covered and perimeter monitoring will continue until ambient air concentrations upwind and downwind of the Exclusion Zone are equal. The limits of the Exclusion Zone will be marked with high visibility flagging tape or four or more traffic cones or similar devices.

The Exclusion Zone will be accessed through a marked Contamination Reduction Zone (CRZ). The CRZ shall be used for gross decontamination of both personnel and equipment items. It shall be configured to allow the decontamination of the field crew while upwind of the Exclusion Zone. The Site Health and Safety Coordinator or his designee will assure that all personnel entering the Exclusion Zone wear the required protective equipment and that upgraded level of protection equipment is readily available.

As work activities will be conducted throughout the Site and off-property, a centralized decontamination facility will be used for the full decontamination of drilling and sampling equipment and personnel.

All decontamination materials and liquids from all areas will be properly collected and will be secured in a fenced storage area until proper disposal occurs.

#### **4.3 Personal Protective Clothing and Respiratory Protection**

The following scheme will be used to designate the required level(s) of personal protective equipment and respiratory protection: the alphabetical designations "B," "C," and "D" shall refer specifically to levels of respiratory protection, namely pressure-demand air supplying respirators with escape provisions, air purifying respirators, and no respiratory protection, respectively. Since potential dermal exposure hazards may require a wide variety of personal protective clothing without regard to the required level of respiratory protection, the numerical designations "1," "2," and "3" will be used to specify the level of protective clothing that is to be employed in addition to the designated level of respiratory protection as described below (i.e., the level of protective equipment can be completely defined by a designation of "C-2," "B-1," etc.). The required levels of protective equipment and upgrade criteria for each work task are specified in Table D4. All equipment and clothing shall be inspected by the wearer prior to use. All suspect protective equipment will be rejected and disposed of as non-contaminated waste.

The initial level of personal protective clothing required during most Site activities will be D-1 which consists of the following:

##### **LEVEL 1 PROTECTIVE CLOTHING**

1. Standard work clothes (long pants and sleeved shirt);
2. Steel toed boots;
3. Safety glasses;
4. Orange safety vests (when working near public traffic);
5. Hard hats (when an overhead hazard is possible) and;
6. Hearing protection (during drilling and other noise producing activities).

Upgraded protective clothing shall consist of the following:

**LEVEL 1, MODIFIED PROTECTIVE CLOTHING**

1. Level 1 protective clothing;
2. Liner latex gloves; and
3. Outer NBR gloves.

**LEVEL 2, PROTECTIVE CLOTHING**

1. Level 1 protective clothing;
2. Inner latex gloves;
3. Outer NBR gloves; and
4. Polycoated Tyvek or Tyvek coveralls with taped openings.

Polycoated Tyvek will be worn where it is probable that there will be contact with subsurface soils, groundwater and/or surface water containing PCBs and/or pesticides. Polycoated Tyvek will also be worn when working in muddy conditions.

If conditions are found which are beyond the required Level(s) of Protection, personnel are to leave the area immediately and obtain the required protective equipment. Should the personnel suspect an inhalation hazard (e.g. unusual and continuous odors, dizziness, or respiratory irritation), they are to immediately move upwind from the area and promptly notify the Health and Safety Coordinator. Work will not proceed in these areas until the nature of the hazard has been assessed by air monitoring and additional protective measures are employed to the satisfaction of the Site Health and Safety Coordinator. Re-entry will be from an upwind position (when possible). Monitoring will proceed re-entry. Personnel who experienced symptoms will not re-enter the area until symptoms have subsided and additional equipment/precautions are employed as determined by the monitoring. An examination by a physician may be prudent depending on the symptoms and duration.

#### **4.4 Decontamination**

Decontamination will involve two phases. Gross decontamination of personnel and equipment, comprising removal of mud by dry brushing or scraping, will take place in the Contamination Reduction Zone established at the site of each intrusive activity. All soil removed in this way will be backfilled into the borehole or test pit or collected and secured in a fenced storage area. All personnel and equipment will undergo gross decontamination prior to moving to a new investigation location on the Site. Prior to leaving the Site, personnel and equipment will undergo full decontamination at the central decontamination pad. Where appropriate to avoid possible cross contamination, (for example between installation of monitoring wells) full decontamination, by steam cleaning, of drilling tools will also take place between investigation locations. The location of the decontamination pad is shown on Figure B1 of the SAMP.

##### Decontamination Procedures

All personnel involved in intrusive activities and/or contaminated personnel shall decontaminate prior to leaving the site. The Decontamination Pad area shall have plastic sheeting on the ground of sufficient size to contain the personnel, hand held equipment and decontamination materials required. A typical Decontamination Area will require:

- 2 wash tubs (1 wash, 1 rinse);
- several scrub brushes;
- disposable towels and plastic bags;
- seating to facilitate boot removal;
- decontamination solution (e.g. Alconox);
- duct tape;
- hand soap;
- skin wash water source; and
- special rinse solutions for hand sampling tools (see SAMP).

Personnel will follow the decontamination procedure below. At a minimum all personnel will wash their hands and face prior to eating, smoking or leaving the Site. The Site Health and Safety Coordinator shall inspect personnel and non-disposable protective equipment for cleanliness prior to release from the Site.

**Station 1: Equipment Drop**

Deposit equipment used on-site (hand tools, sampling devices and containers, monitoring instruments, clipboards, etc.) on plastic drop cloths. Segregation at the drop reduces the probability of cross contamination. During hot weather operations, a cool down station may be set up within this area.

**Station 2: Outer Garment, Boots, and Gloves Wash and Rinse**

Scrub boots, outer gloves and splash garments (if worn) with decon solution. Rinse off with water.

**Station 3: Outer Glove Removal**

Remove outer gloves. Deposit in container with plastic liner.

**Station 4: Cartridge or Respirator Change (if applicable)**

If worker leaves exclusion zone to change cartridges (or respirator), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves donned, joints taped, and worker returns to duty.

**Station 5: Boot, Gloves and Inner Garment Removal (if applicable)**

Boots, protective suit, inner gloves removed and deposited in disposal containers.

**Station 6: Respirator Removal (if applicable)**

Respirator is removed. Avoid touching face with fingers, respirator deposited on plastic sheet.

**Station 7: Field Wash**

Hands and face are thoroughly washed. Shower as soon as possible.

Monitoring equipment and hand tools shall be retrieved and decontaminated using methods appropriate for the type of equipment. Containing equipment in plastic (as applicable) prior to site entry will expedite decontamination. The Health and Safety Coordinator shall inspect the equipment for cleanliness.

Certain sampling equipment (e.g. hand sampling tools) may require specific decontamination procedures and/or chemicals. Site personnel are to refer to the SAMP for this information.

All acid use is restricted to the centralized decontamination area shown in Figure B1 in the SAMP. This area will be equipped with a 15 minute eye wash station.

All chemicals brought to the Site will have the appropriate Material Safety Data Sheet(s) (MSDS) provided to the Health and Safety Coordinator. This requirement also applies to drilling materials.

All disposable personal protective equipment will be double bagged in plastic bags and disposed of as municipal wastes. All decontamination materials will be drummed in 55-gallon drums. The solids and liquids will be separated. The liquids will be subsequently disposed into the on-site 10,000 gallon holding tank and the solids will be properly disposed as Investigation Derived Waste.

Drill rigs and excavation equipment decontamination will follow the methods described in the SAMP.



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## 5.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

If an unanticipated, potentially hazardous situation arises as indicated by visible contamination, unusual or excessive odors, Site personnel shall temporarily cease operations, move away to a safe area, and contact the Site Health and Safety Coordinator. The following procedures have been established to deal with emergency situations that might occur during Site and off-property activities. Prior to starting work at the Site, the local emergency response services will be contacted and informed that field activities will be in progress. Site personnel will familiarize themselves with the location of the nearest phones and medical facilities on arrival at the Site. In the event of a serious emergency situation (e.g. medical problems beyond routine first aid, explosive gas concentrations, or fire beyond incipient stage), Site personnel shall contact the Carlstadt Police Department, inform them of the nature of the emergency, and then notify Golder Associates Health and Safety personnel. When help arrives, Site personnel shall defer all emergency response authority to appropriate responding agency personnel. Emergency notification information is summarized in Attachment D4 of this document.

Carlstadt is served by local police, medical and fire services and is able to provide first response to all emergencies which might occur at the Site or off-property.

### 5.1 Medical Emergency Response Plan

The nature of chemical contamination on this project is not anticipated to present an immediate threat to human health. Other than removal of outer protective garments and gross contamination (e.g., mud), immediate emergency treatment of injuries should therefore generally take precedence over personal decontamination.

Should any person on the Site be injured or become ill, initiate the following emergency response plan and notify the on-Site Health and Safety Coordinator and Personnel Department as soon as possible:

1. If able, the injured person should proceed to the nearest available source of first aid. If the injured party is extremely muddy, remove outer garments and if necessary, wash the injured area with soap and water. If the "injury" involves a potential overexposure to hazardous gases or vapors, (headache, dizziness, nausea, disorientation), get the victim to fresh air and take him or her to the Meadowlands Hospital, Meadowlands Parkway, Secaucus, New Jersey, (see Figure D1) telephone (201) 348-9300, for a complete physical examination as soon as possible.

If the injury involves foreign material in the eyes, immediately flush the eyes with emergency eye wash solution and/or rinse with copious amounts of potable water. Obtain or administer first aid as required. If further medical treatment is required, seek professional medical assistance as discussed below.

Appropriate measures should be taken to protect the privacy of workers in connection with putting on and taking off of protective clothing.

First aid providers shall wear latex gloves when providing any first aid. Severe injuries involving large quantities of blood require that first aid providers don Tyvek coveralls and safety glasses in addition to gloves.

2. If the victim is unconscious or unable to move, or if there is any evidence of spinal injury, do not move the injured person unless absolutely necessary to save his or her life, until the nature of the injury has been determined. Administer rescue breathing using a CPR barrier if the victim is not breathing, control severe bleeding and immediately seek medical assistance as discussed below.
3. If further medical treatment is required and
  - a. the injury is not severe, contact Meadowlands Hospital (201) 348-9300 and take the injured party to the hospital by private automobile.

**Directions to the Hospital:**

From the Gotham Parkway and Paterson Plank Road, turn left onto Paterson Plank Road.

At the "y" in the road take Route 3 east, toward the Lincoln Tunnel Follow Route 3 across the Hackensack River Bridge and stay in the right lane following the blue "H" hospital signs.

Take the ramp at the end of the bridge and make a left onto Meadowlands Parkway

Continue on this road for 4 traffic lights, the hospital is at the fourth light on the right side.

- b. the injury is severe, immediately call Carlstadt Police Department at (201) 438-4300 or 911 using a standard phone.

In both cases, if decontamination is not undertaken, appropriate precautions should be taken to avoid transfer of contaminants to vehicles and other facilities. This can be done by using plastic sheeting or the exposure blanket contained in the first aid kit.

4. Any injured person taken to the hospital shall be accompanied by an individual designated by the Site Health and Safety Coordinator to ensure prompt and proper medical attention. After proper medical treatment has been obtained, the designated companion should notify the Health and Safety Officer and prepare a written report. Site personnel shall maintain their medical insurance identification at the Site whenever they are on Site.

In the event that any personnel are injured at the site during any phase of the Investigation, all available technical information and supporting documentation shall be provided to any treating physicians, or treating health care workers or facilities.

## **5.2 Fire and Explosions**

Dry chemical fire extinguishers are effective for fires involving ordinary combustibles such as wood, grass, flammable liquids, and electrical equipment. They are appropriate for small, localized fires such as a drum of burning refuse, a small burning gasoline spill, a vehicle engine fire, etc. No attempt should be made to use these extinguisher for well established fires or large areas or volumes of flammable liquids.

In the case of fire, prevention is the best contingency plan. There will be no smoking on Site except in pre-designated areas. In the event of a fire during drilling or well installation, personnel shall attempt to extinguish the fire with on-site fire extinguishers. If a fire cannot be controlled in this manner, personnel shall notify the Site Health and Safety Coordinator and follow the procedure outlined below.

Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry grass. Personnel should avoid driving over dry grass that is higher than the ground clearance of the vehicle, and be aware of the potential fire hazard posed by the catalytic converter, at all times. Never allow a running vehicle to sit in a stationary position over dry grass or other combustible materials.

1. In the event of a fire or explosion:
2. If the situation can be readily controlled with available resources without jeopardizing the health and safety of Site personnel, take immediate action to do so. If not:
3. Isolate the fire to prevent spreading, if possible.
4. Clear the area of all personnel working in the immediate vicinity.
5. Immediately notify site emergency personnel and the Carlstadt Fire Department. (201) 438-4300 or 911 using a standard phone.

### **5.3 Chemical Exposure First Aid**

In an event of exposure to chemicals through inhalation:

1. Move the victim to an up-wind location for fresh air.
2. Signal for help.
3. Initiate CPR to revive the victim, if necessary.
4. Contact Carlstadt Police Department, if necessary.

For exposure through dermal route (including eyes):

1. Wash the affected area with copious fluids for at least fifteen (15) minutes (Signal for help if necessary).
2. If irritation persists, seek professional medical care.

For ingestion:

1. Drink a large amount of water to dilute the contaminant(s).
2. Transport the victim to the hospital. Take a copy of this HASP to the hospital.

If decontamination is not undertaken prior to transporting the victim to the hospital, appropriate precautions should be taken to avoid transfer of contaminants to vehicles and other facilities.

### **5.4 Unforeseen Circumstances**

The health and safety procedures specified in this plan are based on the best information available at the time. Unknown conditions may exist, and known conditions may change. This plan cannot account for every unknown or anticipate every contingency. Should

personnel suspect or encounter areas of substantially higher levels of contamination, or should any situation arise which is obviously beyond the scope of the safety procedures specified herein, work activities shall be modified (such as by moving to another location) or halted pending discussions with the Health and Safety Officer and implementation of appropriate protective measures.

### **5.5 Accident and Incident Reports**

If an incident or accident occurs, the Health and Safety Officer and Project Manager shall be notified and the Incident Report (shown in Attachment D5) shall be completed. The report shall be completed by an eye witnesses (if possible) along with assistance from the Site Health and Safety Coordinator. The report will be forwarded to the Health and Safety Officer as soon as possible for further investigation or follow up.

### **5.6 Emergency Contacts**

Emergency notification information is summarized in Attachment D4 of this document.

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**Table D1**  
**Maximum Chemical Constituent Values**  
**216 Paterson Plank Road Site**

Chemical	Water Table Groundwater, ppb	Shallow Soils, ppb
aldrin	NR	57000
arsenic	1600	60000
benzene	7270	53900
cyanide	NR	NR
dieldrin	NR	57000
hydrogen sulfide	NR	NR
lead	1500	2750
methane	NR	NR
PAH, fluoranthrene	266	15300
PAH, phenanthrene	11	23600
PAH, pyrene	228	12700
PCBs	17000*	15083000*
tetrachloroethylene	24500	4290000
trichloroethene	161000	2060000

**Notes:**

NR: Not Reported

ppb: parts per billion

\*": total for all PCBs

Reference: Final RI Report (1990)

**Table D2**  
**Airborne Exposure Limit Information**  
**216 Paterson Plank Road Site**

Chemical	OSHA PEL	NIOSH REL	ACGIH TLV	IDLH	Ionization Potential, eVolts	MicroTip II Response Factor	Odor Threshold, ppm
aldrin	0.250 mg/m3	NE	0.25 mg/m3	10mg/kg	NR	NR	--
arsenic	0.010 .mg/m3	0.002 mg/m3 C	0.01 mg/m3	20 mg/m3	NA	NA	--
benzene	1 ppm	0.1 ppm	10 ppm	3000 ppm Ca	9.24	0.6	34 - 119
cyanide (HCN)	4.7 ppm short term	4.7 ppm short term	10 ppm ceiling	50 ppm	13.9	NR	0.1 - 5.0
dieldrin	0.250 mg/m3	NE	0.25 mg/m3	10 mg/kg	NR	NR	--
hydrogen sulfide	10 ppm	10 ppm C	10 ppm	300 ppm	10.46	NR	0.001 - 0.13
lead	0.05 mg/m3	0.1 mg/m3	0.15 mg/m3	700 mg/m3	NA	NA	--
methane	NE	NE	NE	5% (LEL)	13	NR	odorless
PAH, fluoranthrene	0.2 mg/m3	0.1 mg/m3	0.2 mg/m3	700 mg/m3 Ca	varies	NR	--
PAH, phenanthrene	0.2 mg/m3	0.1 mg/m3	0.2 mg/m3	700 mg/m3 Ca	varies	NR	--
PAH, pyrene	0.2 mg/m3	0.1 mg/m3	0.2 mg/m3	700 mg/m3 Ca	varies	NR	--
PCBs, 54% chlorine	0.5 mg/m3 skin	0.001 mg/m3	0.5 mg/m3	5 mg/m3, Ca	unknown	unknown	--
tetrachloroethylene	25 ppm	minimize	25 ppm	500 ppm, Ca	9.32	NR	47
trichloroethene	50 ppm	25 ppm	50 ppm	1000 ppm Ca	9.45	0.6	82

OSHA PEL: Occupational Safety and Health Administration Permissible Exposure Limit

NIOSH REL: National Institute of Occupational Safety and Health Recommended Exposure Limit

ACGIH TLV: American Conference of Governmental Industrial Hygienists Threshold Limit Value

IDLH: Immediately Dangerous to Life or Health

ppm: parts per million

Ca: carcinogen

lowest feasible: reduce exposure to lowest feasible concentration

minimize: minimize exposure

mg/m3: milligrams per cubic meter

mg/kg: milligrams per kilogram of body weight (Sax)

NE: Not Established

NA: Not Applicable

NR: Not Reported

"--": not available

**Table D3  
Task/Risk Analysis  
216 Paterson Plank Road Site**

This table details site activities and anticipated associated risks by class: Biological, Chemical, or Physical. Personal Protective Equipment level, weather, air temperature and season may effect the magnitude of some types of risk. Site personnel shall use prudent judgement at all times.

Task/Activity	Hazard		
	Biological	Chemical	Physical
Walk Through	L	L-M	M
Groundwater Sampling	L	L-M	L-M
Drilling, Rock Coring	L	L-M	M
Slug Testing, Packer Testing	L	L-M	L-M
Borehole Geophysical Testing	L	L	L-M

Many of the chemicals identified in the on site media can enter through the skin. This route of entry must be protected whenever skin contact is probable.

L: Low  
M: Moderate  
H: high



**Table D4**  
**Levels of Personal Protection and Upgrade Criteria**  
**216 Paterson Plank Road Site**

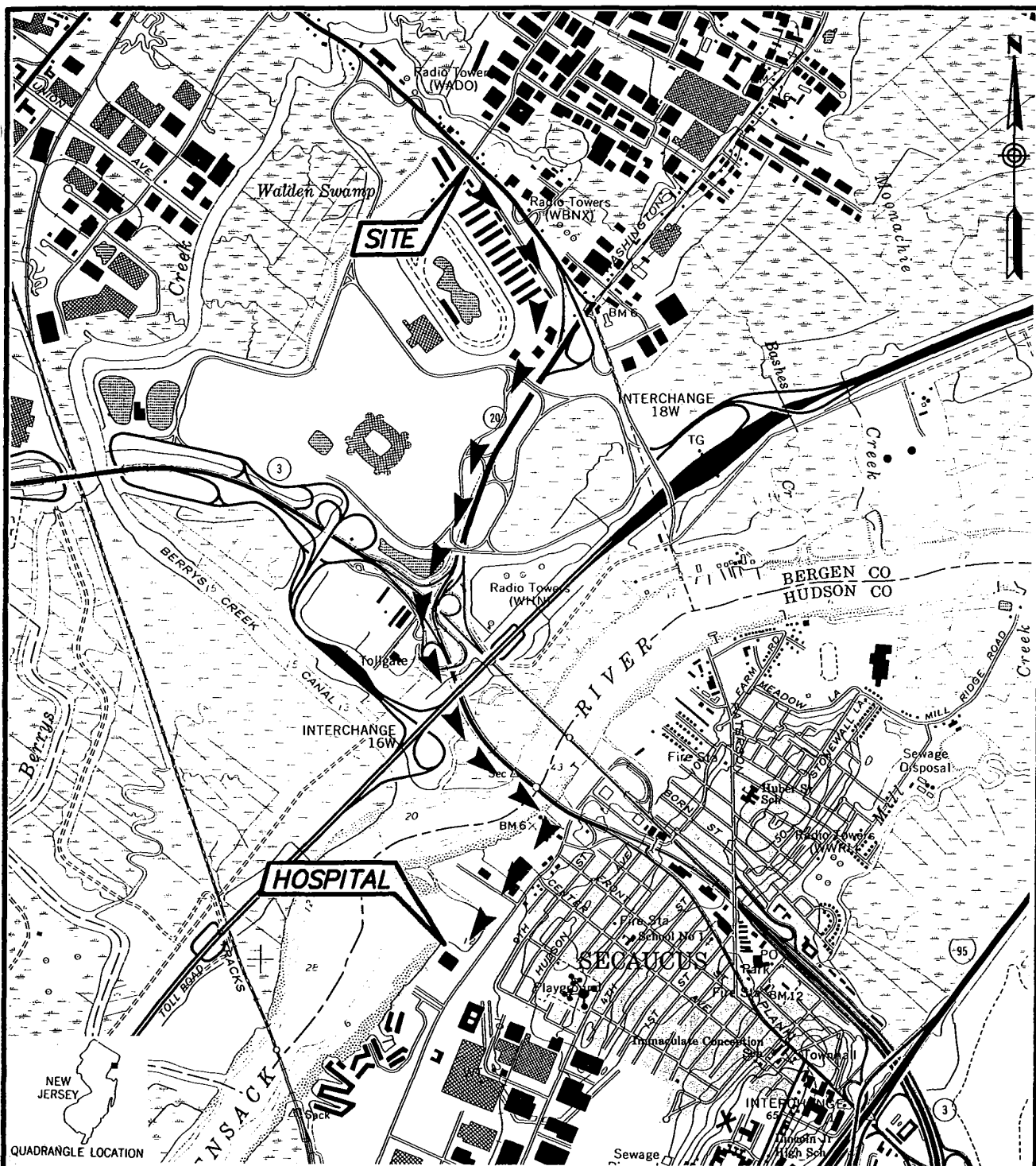
Task	Initial Level of Protection	Air Monitoring Equipment	Upgrade Criteria	Upgraded Level of Protection
Walk Through	D1	NA	Condition Dependent	Condition Dependent
Groundwater Sampling	D2	PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm  Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	C2  Temporarily cease work until concentration subsides and evacuate immediate area or B2
Drilling, Rock Coring	D2	MSA 361	LEL:>10%, <20%  >20%  H2S:>10 ppm for more than 1 hour, or >15 ppm for more than 15 minutes, or >25 ppm at any time  O2: confined space entry <19.5%	Continue with Caution  Temporarily cease work until concentration subsides and evacuate immediate area  Temporarily cease work until concentration subsides and evacuate immediate area or B2  Entry PROHIBITED or B2
		PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm  Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	C2  Temporarily cease work until concentration subsides and evacuate immediate area or B2
Well Installation	D1	PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm  Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	C2  Temporarily cease work until concentration subsides and evacuate immediate area or B2

**Table D4  
Levels of Personal Protection and Upgrade Criteria  
216 Paterson Plank Road Site**

<b>Task</b>	<b>Initial Level of Protection</b>	<b>Air Monitoring Equipment</b>	<b>Upgrade Criteria</b>	<b>Upgraded Level of Protection</b>
Slug Test, Packer Test, Borehole Geophysical Testing	D1, modified	PID	VOCs continuously greater than background, or >5 ppm above background for short intervals or any peak >10 ppm  Continuously greater than 25 ppm, or frequent peaks greater than 50 ppm	C2   Temporarily cease work until concentration subsides and evacuate immediate area or B2
Drill Rig/ Equipment Decontamination	D1 plus Goggles or Faceshield, Gloves Rain suit	NA	NA	NA

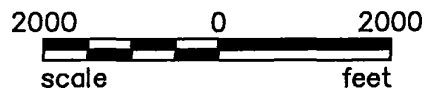
Condition Dependent: Personnel are to use prudent judgement and select additional PPE based on current Site conditions (e.g., wet or muddy) to prevent unnecessary contamination.

Site personnel are permitted, with HSO approval, to substitute protective aprons and/or gauntlets when exposure to water/sediment samples is readily controlled. This substitution is permitted to reduce the possibility of heat stress caused by working in full coverall protection.



## REFERENCE

- 1.) USGS 7.5 MINUTE WEEHAWKEN QUADRANGLE, NEW JERSEY - NEW YORK, DATE 1967, PHOTOREVISED 1981.



JOB No.:	943-6222	SCALE:	AS SHOWN
DR BY:	JSG	DATE:	05/26/95
CHK BY:	SDM	FILE No.:	NJ03-260
REV BY:	PLP	DR SUBTITLE:	03

## SITE AND NEAREST HOSPITAL

**Golder Associates**

216 PATERSON PLANK ROAD SITE

FIGURE

**D1**

R2-0000260

**Attachment D1**

**Field Procedures Change Authorization Form**

Instruction Number: \_\_\_\_\_ Duration of Authorization Requested \_\_\_\_\_ Date: \_\_\_\_\_  
 to be changed \_\_\_\_ Today only  
 \_\_\_\_ Duration of Task

**Justification:**

**Verbal Authorization Received From:**

Time

### Title

Approved By

**R2-0000262**

**Attachment D2**  
**Safety Briefing Statement**

**Attachment D2**

**Site Health and Safety Plan Acknowledgement**

I have read understand and agree to follow the provisions detailed in the Health and Safety Plan for the 216 Paterson Plank Road Site.

I am aware of emergency procedures, equipment locations, and emergency telephone numbers.

I understand that my failure to comply with these provisions may lead to disciplinary actions and/or my dismissal from the Site.

Printed Name	Organization	Signature	Date

This form is to be kept on file on Site. Copies should be made available to personnel from all companies involved with Site work.

**Attachment D3**

**Report Form for Unsafe Conditions and Practices**



**Attachment D3**

**REPORT FORM FOR UNSAFE CONDITIONS AND PRACTICES**

**DESCRIPTION OF UNSAFE CONDITION OR PRACTICE** \_\_\_\_\_

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**DESCRIPTION OF CIRCUMSTANCES SURROUNDING UNSAFE CONDITION  
OR PRACTICE** \_\_\_\_\_

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**IS THIS AN EXISTING CONDITION OR POTENTIAL HAZARD?** \_\_\_\_\_

**REPORTED TO** \_\_\_\_\_

**REPORTED BY** \_\_\_\_\_ **DATE** \_\_\_\_\_

**COMMENTS** \_\_\_\_\_

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**REPORT RECEIVED BY** \_\_\_\_\_

**DATE** \_\_\_\_\_

**Attachment D4**  
**Emergency Notification Numbers**

**Attachment D4**

**EMERGENCY NOTIFICATION NUMBERS**

Medical	(201) 483-4300	Carlstadt Emergency
Police	(201) 483-4300	Carlstadt Emergency
Fire	(201) 483-4300	Carlstadt Emergency
Hospital	(201) 348-9300	Meadowlands Hospital Meadowlands Park Seacucus, NJ
USEPA Project Manager	(212) 637-4410	Richard Puvogel (work)
NJDEP Project Manager	(609) 633-1455	Riché Outlaw (work)
Golder Project Manager	(609) 273-1110	Robert J. Illes (work)
Golder Health & Safety Officer	(713) 931-8674	Charles R. Roberts (work)

**Attachment D5**  
**Incident Report Form**



ATTACHMENT D5

INCIDENT REPORT FORM

In the event of any injury, accident or illness requiring medical attention beyond minor first aid, please complete this form. Retain two copies for your files and send the original to Karen Dierst in the Seattle office.

Employee's office mailing address:

Location of office (if different):

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EMPLOYEE INFORMATION:

Employee's name: \_\_\_\_\_

Length of time with Golder: \_\_\_\_\_

S.S.#: \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_ Sex: M F Birth Date: \_\_\_\_\_

Home address:

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Occupation: \_\_\_\_\_

Department or group: \_\_\_\_\_

PROJECT INFORMATION:

Project number: \_\_\_\_\_ Project Manager: \_\_\_\_\_

Project short title: \_\_\_\_\_ Field Supervisor: \_\_\_\_\_

Project Description (briefly describe the project, location, employee's role, etc.):

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R2-0000270